JUN 15 1959

PIPE LINE INDUSTRY

JUNE
1959

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CONSTRUCTION PROGRESS

Coastal Spreads Beat Weather Delays 40

SPECIAL AD FEATURE

BETTER BATCHING
Rubber Balls Cut Product Mixing 66% 46

AUTOMATIC OPERATION
Latest in Controls on New Laurel Line 52

ECONOMIC DESIGN
How to Find the Optimum Size Crude Line 56

INTERNAL PRESSURE SURVEYS
Smart Pig Tells What It 'Sees' in Line 62

LPG BLENDING
Modified 'Tight Line' Moves Crude-LPGs 68

For a "Quick Look" at this issue, turn the page .

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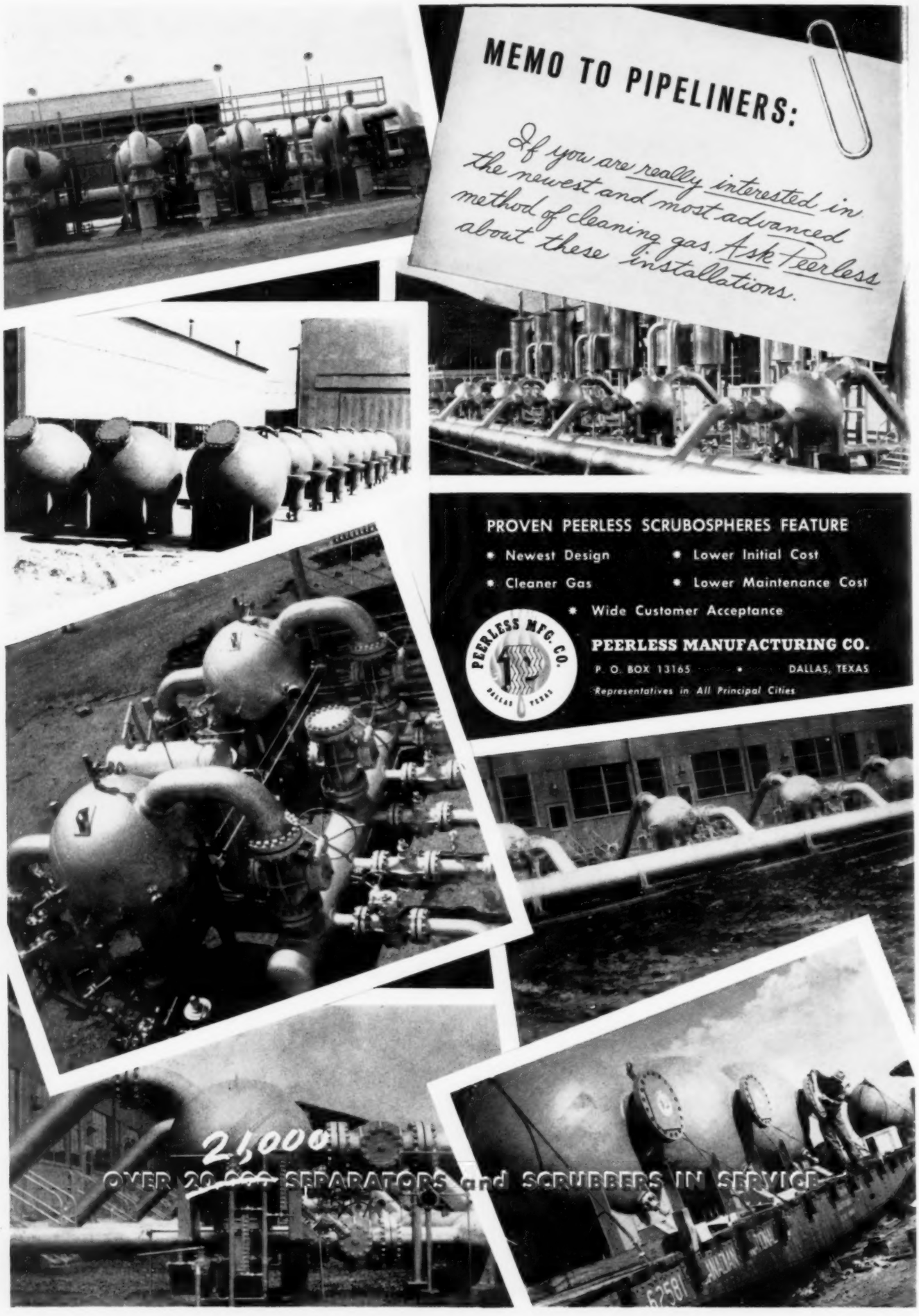
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JUN 15 1959

PIPE LINE INDUSTRY

June, 1959 Vol. 10, No. 6

CONTENTS and Quick Look

To help you put first things first, scan these time-saving digests, checking ☑ those you want to read first.

Coastal Transmission Combines Proven Methods With Promising Advances

☐ Despite heavy rains which halted construction early in the year, Coastal Transmission Corporation completed its 561-mile main line ahead of time for its delivery commitment to Houston Texas Gas & Oil Corporation. Coastal utilized full automatic railhead double-jointing on 79 miles of 24-inch. In laying an 11-mile crossing of the Galveston Bay, Brown & Root, Inc. employed lay barge plus spud barge to pull the line under the Houston Ship Channel allowing traffic to move through the bay. Station design includes unitized compressor engine driven auxiliaries and facilities for on-stream pigging.

Melvin A. Judah and Donald G. De Pugh . . . Page 40

API SECTION

Using Expandable Spheroids for Batch Separation

☐ Extensive experimentation has shown that the spheroid may be the very best means of separating products in a pipe line. Certainly, the expandable spheroid has reduced costs of separating batches on Shell's Wood River-to-Chicago line. Spheroids are easy to launch, easy to receive and there is a simple way to make them bypass a pump station and keep their relative position in the stream.

By M. L. Barrett, Jr. . . . . Page 46

Design Features of Laurel Pipe Line System

☐ This system operates just like the subject of last year's talk on "The Pipe Line of the Future!" It distributes 16 different grades of products to 18 different take-off metering points. Entire operation can be remotely controlled from a central dispatcher's control board.

By James F. Stephenson and Marlan G. Jordan . . . . . Page 52

Re-examination of the Economics of Sizing Crude Lines

☐ There are many factors that must be considered in cost minimization, most of them are variable. Some of these factors are based on predictions of the future; but never-the-less, it is possible to make sizeable savings through these approaches to cost minimization: (1) Proper sizing of pipe line, (2) proper sizing of wall thickness, (3) balancing horsepower against line costs for greatest economy.

By Dr. L. Cookenboo, Jr., and L. W. Smith . Page 56

What Goes on Inside a Pipe Line?

☐ As interpreted by charts produced by a recording pig, the pig makes a pressure traverse which can be used as a basis for calculating profiles or leak location. This experimental work is pointing the way to other records taken from inside the pipe. These will include, grade, curvature, roughness, pressure, temperature, leakage and possibly electrical potential.

By Howard J. EnDean, Robert M. Howard and James E. Knizner . . . . . Page 62

Mixing Crude with LPG Distillates in the Pipe Line

☐ This can be profitable, and the technique will probably receive greater attention in the future. In this instance an "elderly" crude line was adapted to "tight-line" operation to haul LPG with crude from the Cushing area 675 miles to an East Chicago refinery where separation is carried out continuously.

By A. N. Horne . . . . . Page 68

REGULAR MONTHLY DEPARMENTS

Editorial Page 4
Pipe Line Panorama 39
Ideas for the Future 72
Rules of Thumb 73
Pipe Line Hints 74
Construction News 76
On the Line 84
Pipe Line Men in the News 88
Who's Meeting Where 98
Service and Supply Men . . . . . '99
What's New in Equipment 104
New Equipment Literature 117
ADVERTISERS' INDEX 118

PIPE LINE INDUSTRY Published every month. Second class postage paid at Houston, Texas.

Fact vs. Fiction

At too frequent intervals, the nation's press emblazons anti-oil industry articles with headlines that cry out against the depletion provision "pirates" of the oil industry.

Far too many of the statistics presented in these articles are viciously slanted and false—to put the writers' points across, one-sided as they may be.

At too frequent intervals, top government leaders lash out in the nation's press against depletion, "big profit" oil companies and free competition among natural gas producers.

Far too many of the statistics cited in these statements are viciously slanted and false—to put the politicians' points across, one-sided as they may be.

At too frequent intervals, industry competitors and even inter-industry factions attack various phases of the oil industry in the public arena.

Far too many of the statistics presented are viciously slanted and false—to put the authors' points across, one-sided as they may be.

At too frequent intervals, union leaders rip the oil industry apart editorially to raise their stature in the eyes of union members.

Far too many of the statistics presented are viciously slanted and false—to put the unions' points across, one-sided as they may be.

No wonder the public looks on the oil industry as a composite collection of "oil-rich Johnny-come-latelies" —who gain their wealth by fleecing the natural gas consumers, by reaping millions from the 27½ percent "tax loophole," by using collusion to set product prices, by making vast profits from cheap imported oil.

They have little chance to learn the truth.

When the uninformed business "experts," government leaders, union leaders, and industry competitors speak out they hit the front pages with the full cooperation of syndicated columns, wire services and local coverage. When oil leaders give a rebuttal it takes a powerful magnifying glass to find the heavily edited copy on a back page.

Is There an Answer? On the surface it would appear that little can be done to combat the emotional attacks, the biased handling of news and false statistics. However, plenty can be done—if enough responsible oil men can be found who firmly believe in keeping the oil industry economically healthy and free of government control. Oil men who will take positive action and assume the role of industry statesmen, instead of hiding their heads in the sand.

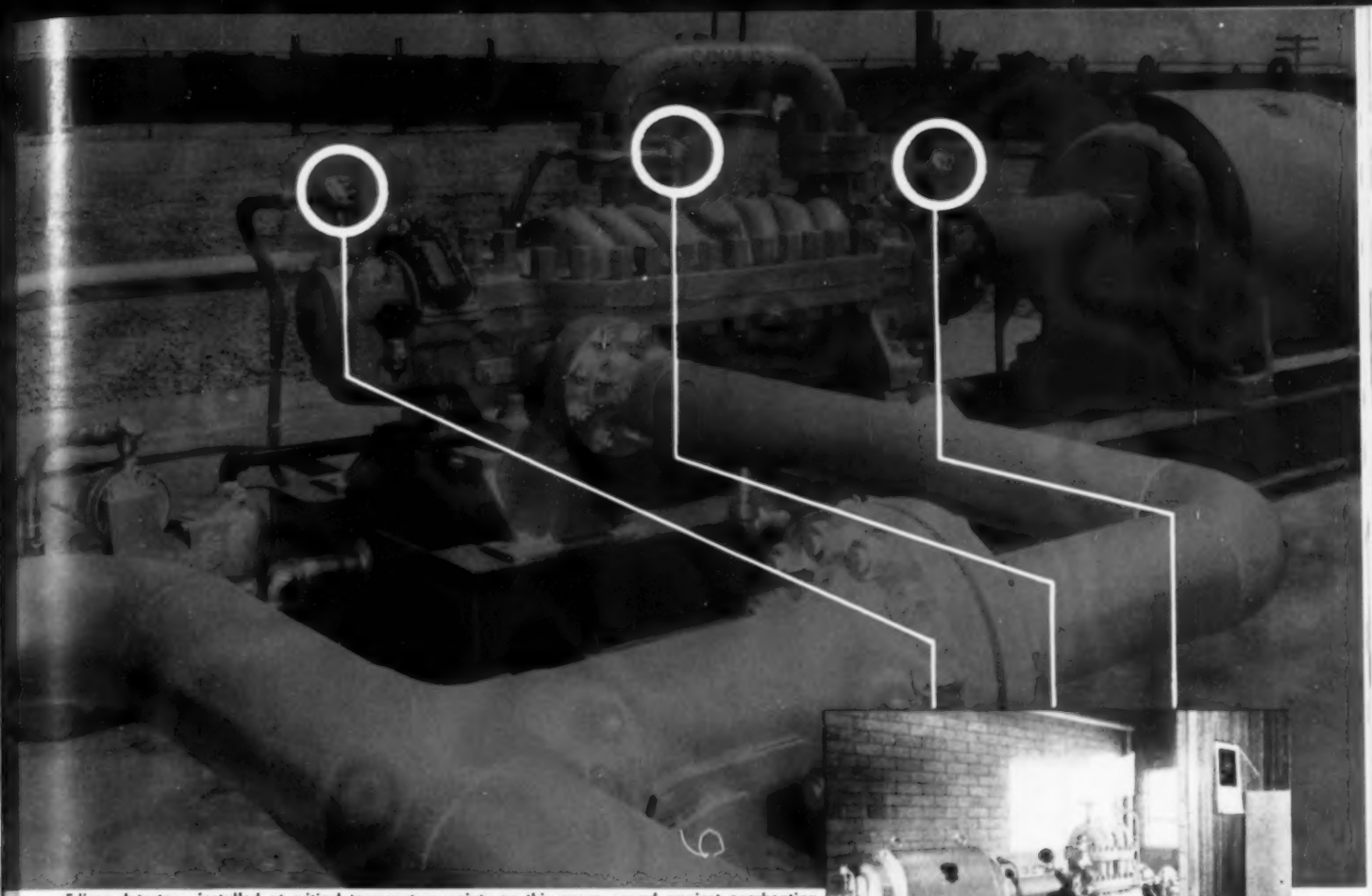
One excellent example of what can be done is the case history of the steel industry's public relations in the current wage negotiations. The same breed of Socialists, politicians, labor leaders, and anti-business fanatics who are twisting the public mind with falsehoods about steel, also speak out against the oil industry.

The steel industry is answering its critics through the personalities of men who have the respect of the nation —Roger M. Blough, R. Conrad Cooper, R. Heath Larry, and others. They have been selected as industry statesmen. They are well equipped to tell the public the true facts about steel industry economics.

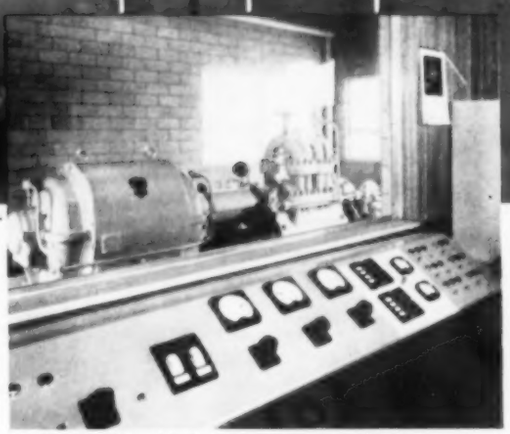
Instead of hoping for the public to pick up that magnifying glass and read the steel industry's side of the controversy, full page ads are being purchased to answer, statistic by statistic, every falsehood that has been uttered.

The oil industry should have no trouble following the same procedure. There are a large number of potential industry statesmen to present the truth about depletion, imports, federal control, prices and other issues used to whip the industry down. And ad space is available to all.

Taking such steps as these would be a small price to pay to keep the oil industry free and economically solvent.



Edison detectors, installed at critical temperature points on this pump, guard against overheating.



Omniguard and indicating units are installed in control console. Warning system identifies a hot bearing by an alarm light and automatically shuts down the equipment. Indicators enable operator to read exact temperature of all bearings from console.

THOMAS A.

EDISON

omniguard systems protect unattended pipeline booster stations

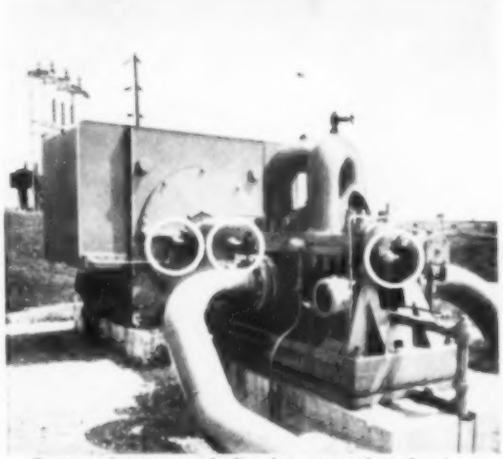
To pump more oil at less cost, pipe line operators use satellite booster stations. These stations are unattended. In order to protect critical equipment operators rely on Edison Omniguard temperature monitoring systems.

Omniguard detectors are installed at critical temperature points such as inboard and outboard sleeve bearings on the motor, inboard and outboard ball bearings on pump. In addition, they monitor pump casing temperature, and temperature of oil on discharge side of pump.

Indicating panel is usually located in supervisory station miles away. In event of overheating, pumping motors are immediately shut down and information is automatically relayed to supervisory station. Trouble-shooting personnel are quickly dispatched to put station back in operation, or standby equipment can be automatically cut-in by Omniguard.

This reliable, economical system is playing a major role in insuring the continuous, profitable operation of more and more pipe line stations.

If you would like further information about the Edison Omniguard system, write for publication 3036C.



Pump and motor at pipeline booster station, showing Edison detectors (circled) on inboard and outboard pump bearings and pump casing.

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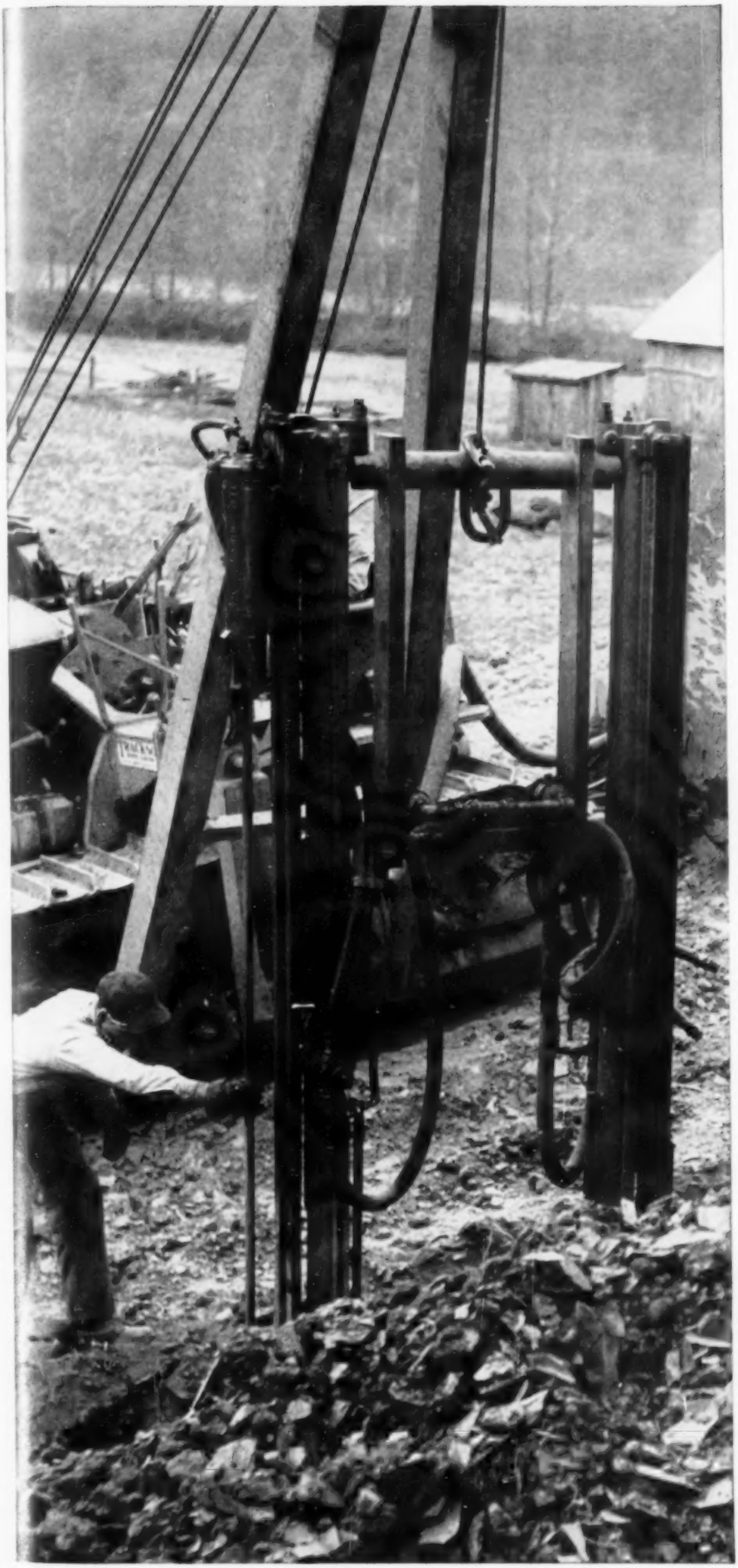

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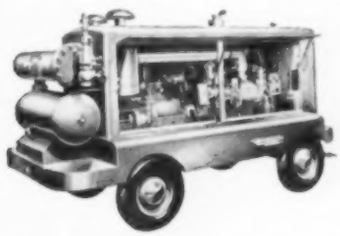
For full details, check with your Jaeger distributor or write us for Catalog JCR-8. Find out why the Jaeger "Roto" is the top performer for today's top pipeline contractors.



Model "600". Equally efficient performance is offered in "365" and smaller sizes.

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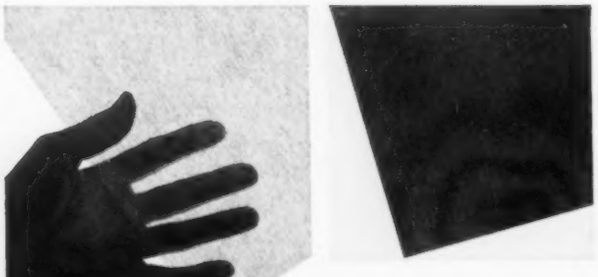

Blue Flag Wrap (left), has uniform porosity for quick bleed-through of enamel. **J-M Asbestos Felt (right),** saturated with coal tar or asphalt, provides a tough outer shell...3 types for field or mill wrapping.

Buyers of pipeline wraps and tapes are now served by an enlarged staff of Johns-Manville sales and technical personnel operating out of 56 sales offices . . . by expanded distribution facilities . . . by the addition of 7 strategically located plants . . . and by expanded research and product development laboratories. For further information, write Johns-Manville, Box 158, New York 16, N.Y. In Canada, Port Credit, Ontario.

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...1 For enamel reinforcement

J-M Blue Flag® Wrap—specially formulated from borosilicate type fiber glass—strengthens pipeline enamels the way steel rods reinforce concrete. It reduces cracking and deformation of the enamel. The inorganic fiber glass can't rot, decay or absorb moisture in the ground . . . will add years of protective life to pipeline enamels.

The uniform porosity of Blue Flag allows the enamel to bleed through quickly. It minimizes holidays and helps form an evenly distributed coating with high resistance to soil stresses.

...2 For a tough outer shell

J-M Asbestos Felts, made of fibrous stone, provide a tough, durable outer shell. During the manufacture—natural asbestos mineral fibers are felted, then impregnated with coal tar or asphalt saturant to provide, literally, "a flexible covering of stone."

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Inert, inorganic asbestos fiber has been uniquely inured by nature over millions of years against rot or decay. Asbestos comes from the ground, is always at home in the ground.

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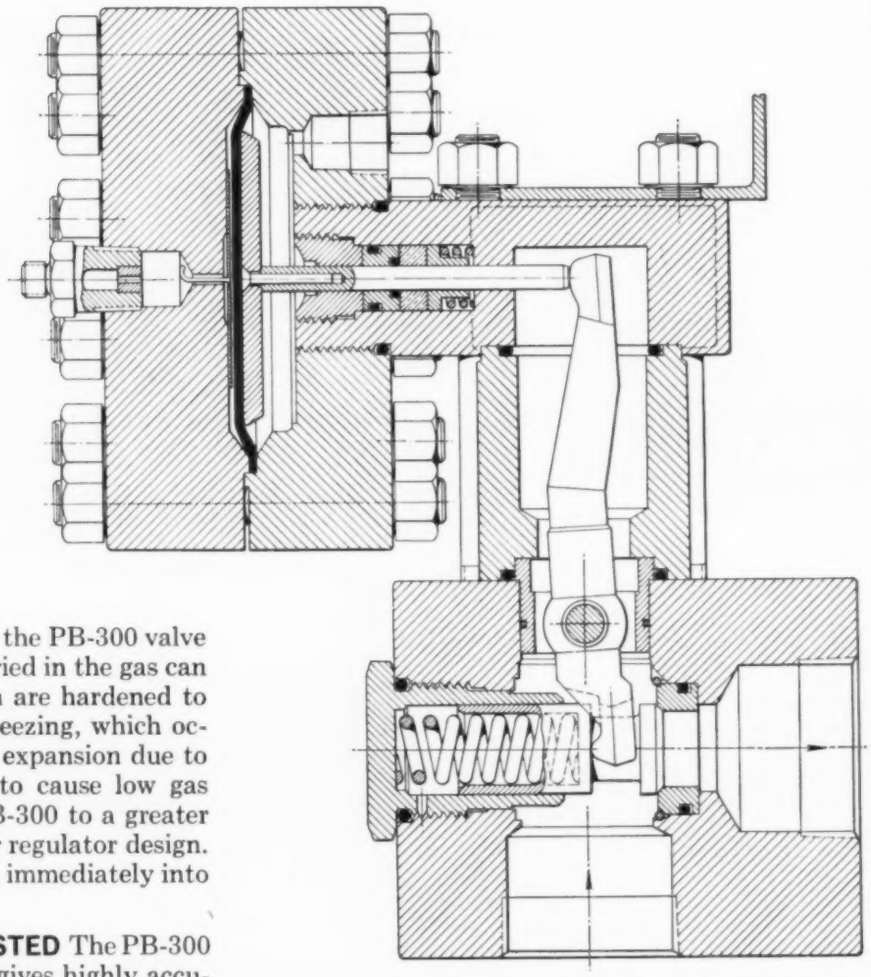
Adapts easily for Pressure Regulation, Back Pressure Service and Automatic Over Pressure or Under Pressure Shutoff



Available in both Angle (shown above) and In-line models with 2" screwed or ring joint flange connections. Inlet pressures to 6000 psi and controlled pressures to 3000 psi.

The flow of high pressure gas through the PB-300 valve is *away* from working parts. Sand carried in the gas can attack only the valve and seat which are hardened to resist cutting and easily replaced. Freezing, which occurs in ordinary regulators when gas expansion due to pressure reduction is great enough to cause low gas temperatures, is minimized in the PB-300 to a greater extent than is possible with any other regulator design. Gas flow through the valve is directed immediately into the unobstructed downstream line.

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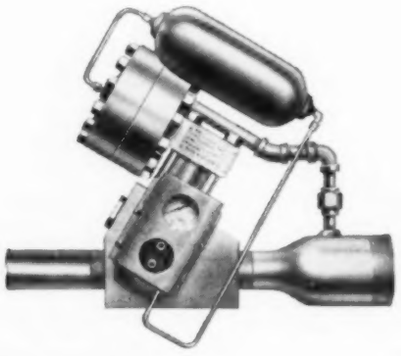

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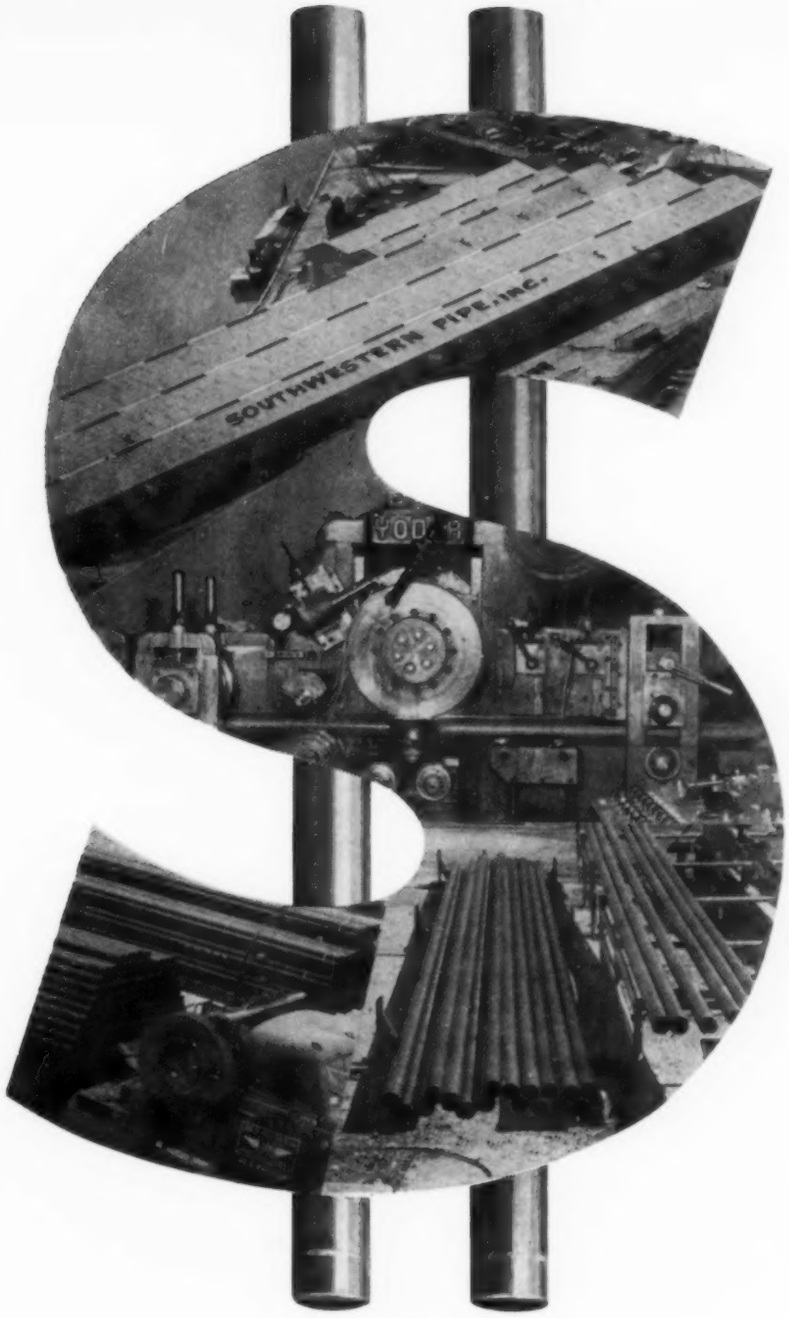

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Southwestern LIGHTWALL Electric Resistance-Weld Line Pipe greatly reduces weight without sacrificing performance . . . delivers actual dollar savings four ways over standard-weight pipe. With Southwestern LIGHTWALL, every customer benefits from savings in initial cost, transportation, installation, and in longer life when given proper corrosion protection. Southwestern LIGHTWALL Electric Resistance-Weld Line Pipe is available in a wide range of wall thicknesses to .188" wall, from 1.315" O.D. to 4.500" O.D. Because of Southwestern's manufacturing flexibility and large inventories of selected steel coils, you can depend on prompt deliveries.

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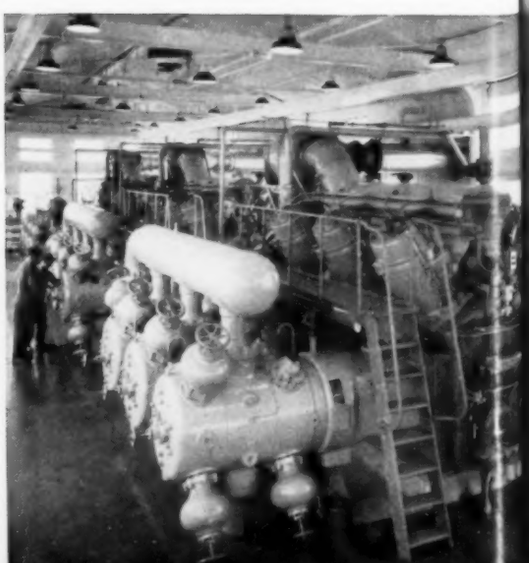
Exterior view of Utica Station.

The three compact 6-cylinder Cooper-Bessemer GMVC Compressors are rated 1000 hp at 300 rpm. Two have been in service since 1957. One was added in 1959.



Victor G. Fulkerson, *Head Engineer, Utica Station, New York State Natural Gas Corporation, explains...*

How the new Utica Station meets growing demands with Cooper-Bessemer Compressors

"Our Utica Station was built in 1957 to boost gas pressure for the mounting demands of the Albany-Schenectady area. It housed two 1000 hp Cooper-Bessemer Series-Turbocharged V-Angle Compressors. Then, a demand for 20 million cubic feet more gas daily required the addition of a third unit of the same type and size this year (1959).

"Averaging about 85 million cubic feet per 24 hours, the station has pumped peak loads of as much as 140 million cubic feet. Entering the station at 400-700 psi, the gas is discharged at 600-900 psi."

FACTS ABOUT COOPER-BESSEMER SERIES-TURBOCHARGED V-ANGLE COMPRESSORS

Peak Load—Plus Capacity. Plenty of reserve power, always ready for those unexpected extra demands, provides a big economy advantage.

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Less Housing Cost. Compact V-angle design, combined with 40% power increase of series turbocharging, means today's highest power-to-space ratio, with no increase in piping or cooling requirements.

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Write For Bulletins. Complete details on Cooper-Bessemer V-Angle Compressors are given in bulletins... free on request. Call our nearest office to help you plan new facilities.

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'59 Ford Pickups beat average mileage of other leading makes by 25.2% in Economy Showdown U.S.A.

Here at last is certified proof of the differences in gas mileage between six-cylinder pickups . . . evidence that you can use in your operation.

It was compiled by America's foremost independent automotive research firm after testing 1959 six-cylinder ½-ton pickups of the six leading makes. The trucks were bought from dealers—just as you would. After at least 600 miles break-in, all were brought up to manufacturers' recommended specifications.

The tests paralleled every kind of driving – high speeds and low, open highways and city traffic, even door-to-door delivery. Acceleration rates were carefully timed in each gear to insure accurate results for all makes. And to reduce any human factor, test drivers were continually shifted from truck to truck. In every test, '59 Ford Sixes delivered more miles per gallon than any other make!

Here are the actual percentages:

'59 FORD PICKUP SIXES GAVE
42.6% better mileage than make "D"
31.1% better mileage than make "I"
25.2% better mileage than make "C"
22.0% better mileage than make "S"
9.6% better mileage than make "G"

Taken together, Ford got 25.2% more miles per gallon than the average of all other leading pickups!

What's the secret of Ford's economy? First, of all pickup sixes, only the Ford Six has modern Short Stroke design which reduces engine friction and thus requires less fuel. Second, to this modern engine, Ford has added a new economy carburetor to meter fuel more precisely in both high- and low-speed ranges.

See your Ford Dealer for the complete report of Economy Showdown U.S.A. Visit him today and get the whole story firsthand.

Jack Long
President
Long & Wetzel, In
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says:

"We've had less downtime with Ford Trucks than with any other make we've used!"

"We service oil wells all over the state of Michigan, plus the northern parts of Ohio and Indiana and I don't think there's a tougher truck operation. Our Ford Trucks are always on the job and most of the jobs take us a long way off the road—in fact we frequently have to make our own roads.

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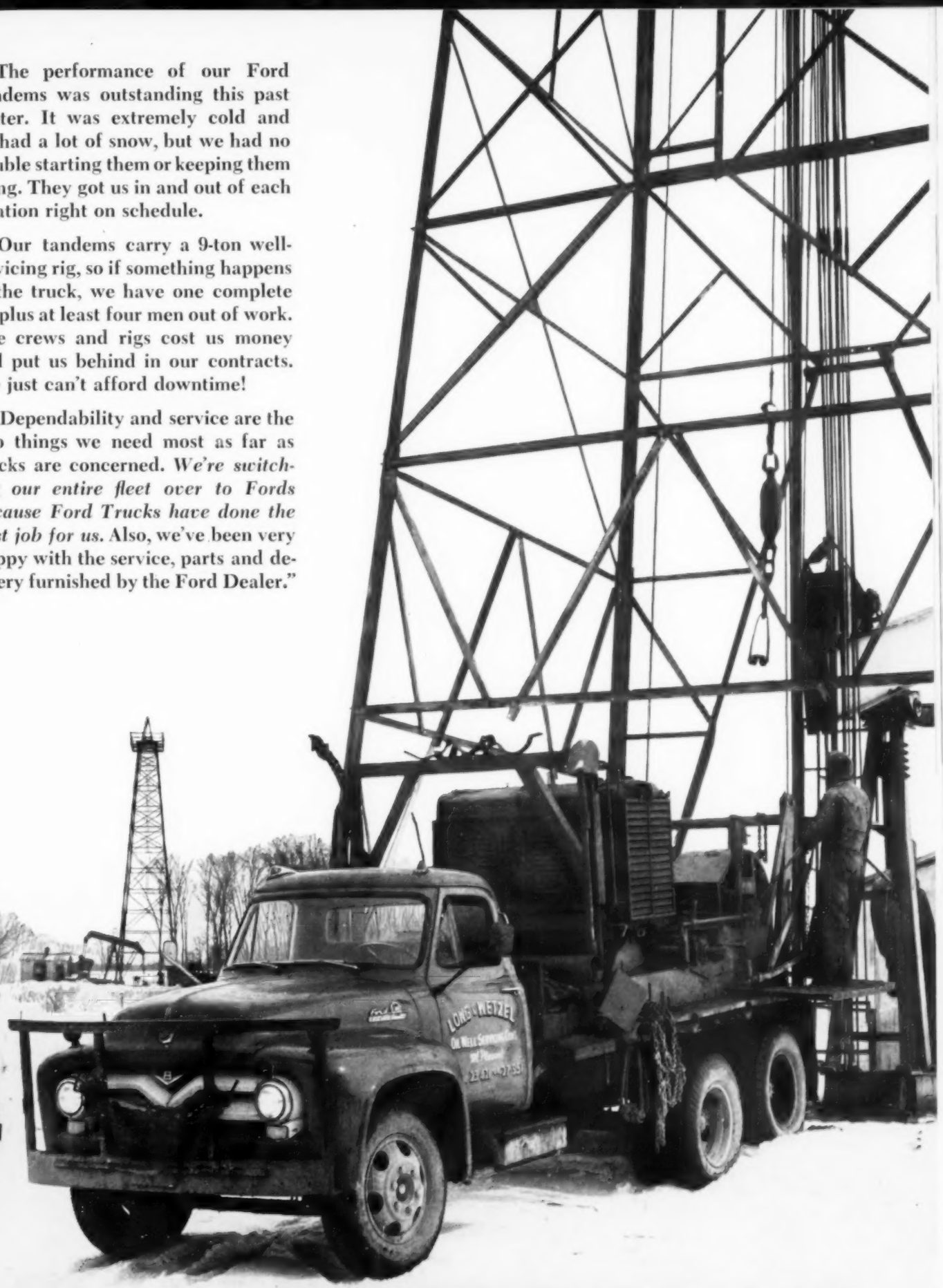
"The performance of our Ford Tandems was outstanding this past winter. It was extremely cold and we had a lot of snow, but we had no trouble starting them or keeping them going. They got us in and out of each location right on schedule.

"Our tandems carry a 9-ton well-servicing rig, so if something happens to the truck, we have one complete rig plus at least four men out of work. Idle crews and rigs cost us money and put us behind in our contracts. We just can't afford downtime!

"Dependability and service are the two things we need most as far as trucks are concerned. *We're switching our entire fleet over to Fords because Ford Trucks have done the best job for us.* Also, we've been very happy with the service, parts and delivery furnished by the Ford Dealer."

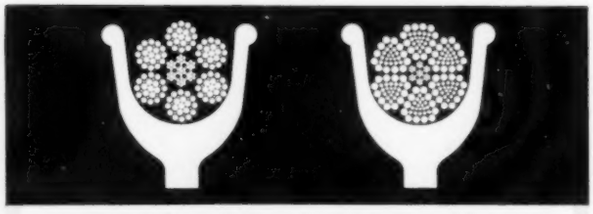


FORD TRUCKS COST LESS

LESS TO OWN . . . LESS TO RUN . . . LAST LONGER, TOO!

SHAPE *with a future*

This is a cross section of one strand of a Flattened Strand Wire Rope showing the triangular arrangement of wires. This is the secret of the success of Yellow Strand Flattened Strand Wire Rope. Visualize how the flat surface of this strand runs smoothly over sheaves and drum on your equipment . . . load weight and wear are distributed over many wires instead of just a few. This construction makes possible a 10% greater metallic area, a marked increase in strength plus a compactness and crush resistance unobtainable in round strand rope. The benefits Yellow Strand Flattened Strand brings to the pipeline industry are obvious . . . longer rope service life, less down time, greater profits! Ask your Broderick & Bascom Distributor about Yellow Strand Flattened Strand. For *your* future's sake specify long-lived, money saving B & B products. Broderick & Bascom Rope Co., 4203 Union Blvd., St. Louis 15, Mo.



LOAD DISTRIBUTED OVER 12 CONTACT POINTS

Compare Yellow Strand Flattened Strand (right) with round strand wire rope (left). Note how Flattened Strand gives 12 points of contact with sheave groove, with consequent greater bearing area and smoother surface. This results in longer service life for rope, sheaves and drum.

Yellow Strand®

Wire Rope

COASTAL TRANSMISSION CORPORATION—STATION No. 6

Station No. 6, located on Coastal Transmission's line near Beaumont, Texas, is being completed on time. Competent field supervision and complete facilities for pipe prefabrication in Contractor's Shreveport shop always assures EARLY completion by:

THE EARLY COMPANY

Engineers & Constructors

SHREVEPORT, LOUISIANA

For more data on advertised products, use Readers' Service Cards, last page.

THE MAN FROM HOBBS SAYS: **THIS ONE HAULS THE CONCENTRATED, BIG LOADS--UP TO 65,000 POUNDS!**

This photo is absolutely unretouched. Get a ruler and check for yourself the minimum deflection caused by this 48,000-lb. International TD24!

ITS SIDE RAILS ARE FABRICATED OF T-1 STEEL

MAKES FSRF STRONG, RESILIENT—

FSRF—Hobbs FABRICATED SIDE RAIL FLOAT—attains both its strength and light weight through use of miracle T-1 steel in its side rails. T-1 will flex three times as far as carbon steel and return to its original position — flexibility that enables the FSRF to withstand top shock loads, lengthens its life as a trailer.

—YET LIGHT ENOUGH FOR HIGHWAY USE!

Amazing thing is that the 35-foot FSRF weighs only 11,148 pounds — yet is rated for a load of 65,000 pounds, concentrated in an area of as little as 16 feet. A centerbeam float big enough to handle this concentrated load will usually weigh 14,000 pounds or more — which means simply a 3,000-pound net gain in legal payload capacity whenever you have to use a big trailer over the highway.

The man from Hobbs can give you more details. Call him today, or write to us at the address below.

Another fine example of

HOBBS TRAILERS

OIL FIELD AND MACHINERY TRANSPORTS

THE MAN FROM HOBBS
- KNOWS TRAILERS
- KNOWS YOUR NEEDS
- SERVES YOU WELL
- IS NEAR YOU

SEE HIM FOR ALL YOUR HAULING JOBS!

HOBBS TRAILERS
609 NORTH MAIN FORT WORTH, TEXAS

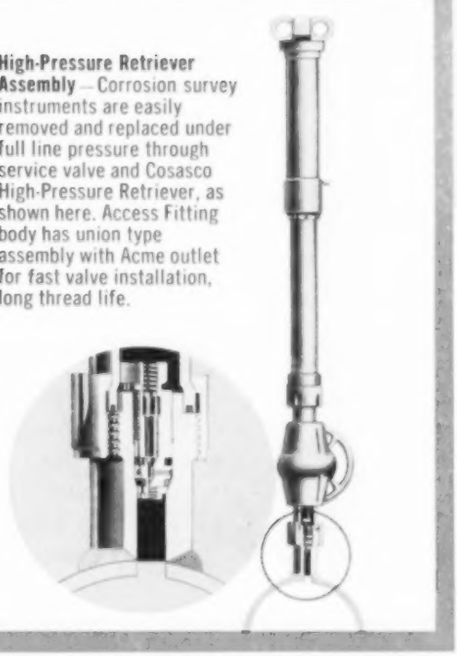
SALES AND SERVICE THROUGHOUT THE WESTERN HEMISPHERE

Positive, accurate DETECTION is your best corrosion protection

COSASCO®

...your key to complete corrosion control without system shutdown!

High-Pressure Retriever Assembly—Corrosion survey instruments are easily removed and replaced under full line pressure through service valve and Cosasco High-Pressure Retriever, as shown here. Access Fitting body has union type assembly with Acme outlet for fast valve installation, long thread life.



Cosasco offers the *only* complete line of corrosion survey instruments for *all* pressure conditions—up to 10,000 psi! Now you can insert and retrieve corrosion coupons, samplers, thermocouples and probes under full line pressure, without interfering with normal operations in any way. The patented Cosasco Access Fitting principle is your key to positive, accurate corrosion survey programs in transmission, storage, injection, recovery and processing equipment—at all times and under all conditions!

Free Corrosion Survey Service. If you have a corrosion survey problem, Cosasco can help you solve it. Send details and blueprints and the Cosasco solution will be worked out promptly—at no cost to you.

Cosasco offers complete line of "use-engineered" corrosion survey instruments. In representative group shown above are (l to r): Thermocouple Survey; Product Sampler; Corrosometer* Probe; Hydrogen Probe (Chiksan swivel type); Hydrogen Probe (Standard type); Disc-type Coupon Holder (bottom of line application); Coupon Holder (Standard inside register type); Coupon Holder (Extension tongue type); Pre-Stressed Coupon Holder.

*T. M. REGISTERED

COSASCO®

DIVISION

PERFECT CIRCLE CORPORATION

11655 McBEAN DR., EL MONTE, CALIFORNIA

EXPORT OFFICE: 3631 ATLANTIC AVENUE, LONG BEACH, CALIFORNIA

SAFETY IN THE RIGHT PERSPECTIVE

with Flexitallic Spiral-Wound Gaskets

In this enlarged sectional view, you can see the Spiral-Wound Gasket construction originated by Flexitallic in 1912. And you can see Flexitallic Blue, the blue dye in the Canadian asbestos filler, which is the mark of an engineered Flexitallic Gasket.

Flexitallic means sealing at its safest. You get performance you can depend on throughout all pressure/temperature ratings, because the compression characteristics of the gasket are always related to the pressure/temperature ratings of the flanges with which they are assembled.

When fluids are confined in a critical pressure/temperature range . . . when flanged joints are subject to thermal and mechanical shock, vibration, weaving, and other joint stresses . . . engineers demand the maximum in gasket performance.

That's why they specify Flexitallic Spiral-Wound Gaskets.

FLEXITALLIC GASKET CO.
8th & Bailey Sts. Camden 2, N.J.

Flexitallic®
SPIRAL-WOUND GASKETS

FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

*Flexitallic is a registered tradename. No one else can make a Flexitallic Gasket. Look for *Flexitallic Blue* — it's our exclusive blue-dyed Canadian asbestos filler.

NEW! HUMBLE NEBULA EP-1 GREASE CARTRIDGES

The NEBULA EP-1 grease cartridge eliminates the worst part of greasing—the messy job of refilling the grease gun from a pail. Just slip the caps off the cartridge, insert it in your grease gun, and you're ready to grease any fitting. There's no waste of grease, and no possibility of dirt or foreign matter getting into the grease.

NEBULA EP-1 is an outstanding multi-use grease. Its exceptional resistance to the effects of heat, water, oxidation and heavy loads makes NEBULA EP-1 top choice for equipment that works outdoors where rain, moisture, dirt, dust and high temperatures are encountered.

NEBULA EP-1 gives excellent lubrication and protection whether your equipment is working at high or low speed, the load is light or heavy, and whether the temperature is hot or cold.

SPECIAL INTRODUCTORY OFFER!

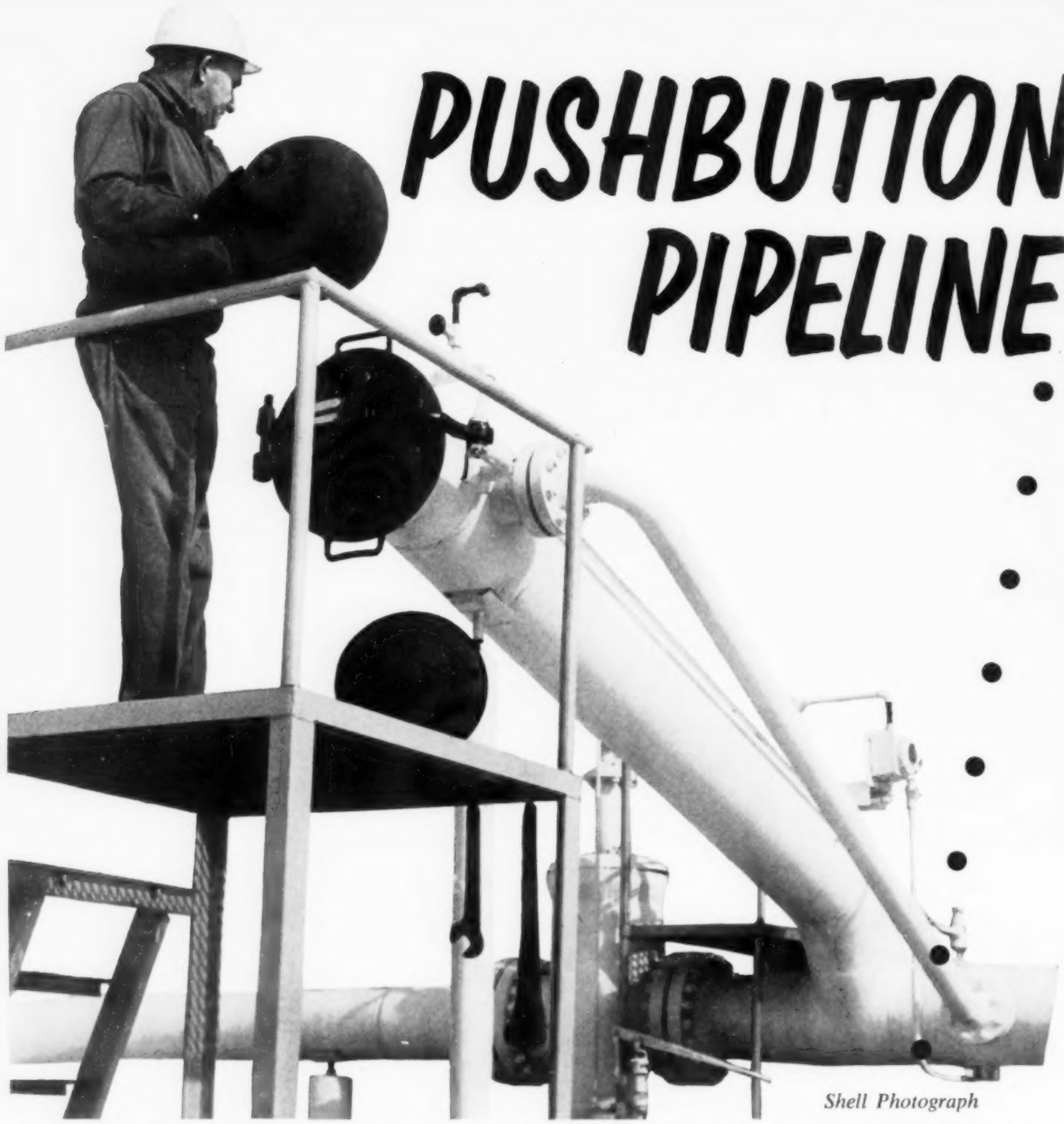
Free lever-action grease gun with every 60-cartridge case of NEBULA EP-1 purchased. But hurry—deadline on this special offer is August 1, 1959.

For quick delivery of NEBULA EP-1 grease cartridges, call your nearest Humble wholesale plant in Texas and New Mexico.

HUMBLE

HUMBLE OIL & REFINING COMPANY

PUSHBUTTON PIPELINE



Shell Photograph

- This "magazine loading" launching barrel contains up to ten Pipe Line Spheres. After initial loading, a Sphere is launched with a push of a button. One or more succeeding Spheres can then be similarly launched at precise intervals as close as six seconds.
- Suitable for Products, Crude, and Natural Gas Pipe Lines, these automatic Sphere handling devices bring the mechanical phase of Pipe Line automation even closer to true "unattended operation." Other associated equipment includes automatic Station Sphere Bypass and Receiving barrels. It is now possible to conduct squeegee operations with Pipe Line Spheres throughout the length of a Pipe Line — fully automatically.
- Applications for automatic Pipe Line Sphere equipment include:
  Crude and Products Pipe Lines — Tender separation; with accurately bracketed interface and consequent reduction in comingling. Positive displacement meter calibration in loops or on-stream.
  Natural Gas Pipe Lines — Liquid removal. Practical two phase operation for complete recovery of distillates with full Pipe Line efficiency.
- Maloney Engineers are prepared to furnish engineering and components for application. Write for further information.

F. H. Maloney COMPANY

Post Office Box 1777 • Houston 1, Texas

Features of Maloney Pipe Line Spheres and Automatic Equipment Described Herein are Subjects of Patents Pending.

Coated and Wrapped Miles Apart

YET...

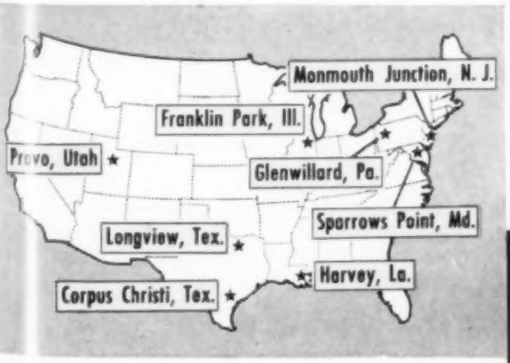
IDENTICAL TWINS!

Dramatic proof of the absolute uniformity of PLS quality-controlled pipeline protection

No matter which Pipe Line Service Plant is applying protection, you can count on the identical high quality standards of *uniform protection* . . . mile after mile of pipe.

Pipe Line Service protection can provide this kind of identical uniformity due to precisely controlled production, using methods and machines which have been specially developed for this purpose over a long period of time.

Why not make sure of maximum service life for your pipe investment . . . with *uniform* Pipe Line Service protection? Like the chain with a weak link, lack of uniformity is equivalent to no protection at all. Get full details from the Pipe Line Service sales office nearest you.



Sales offices at all plant locations . . . and Atlanta, Ga.; Dallas, Tex.; Houston, Tex.; Lincoln, Nebr.; Syracuse, N. Y.

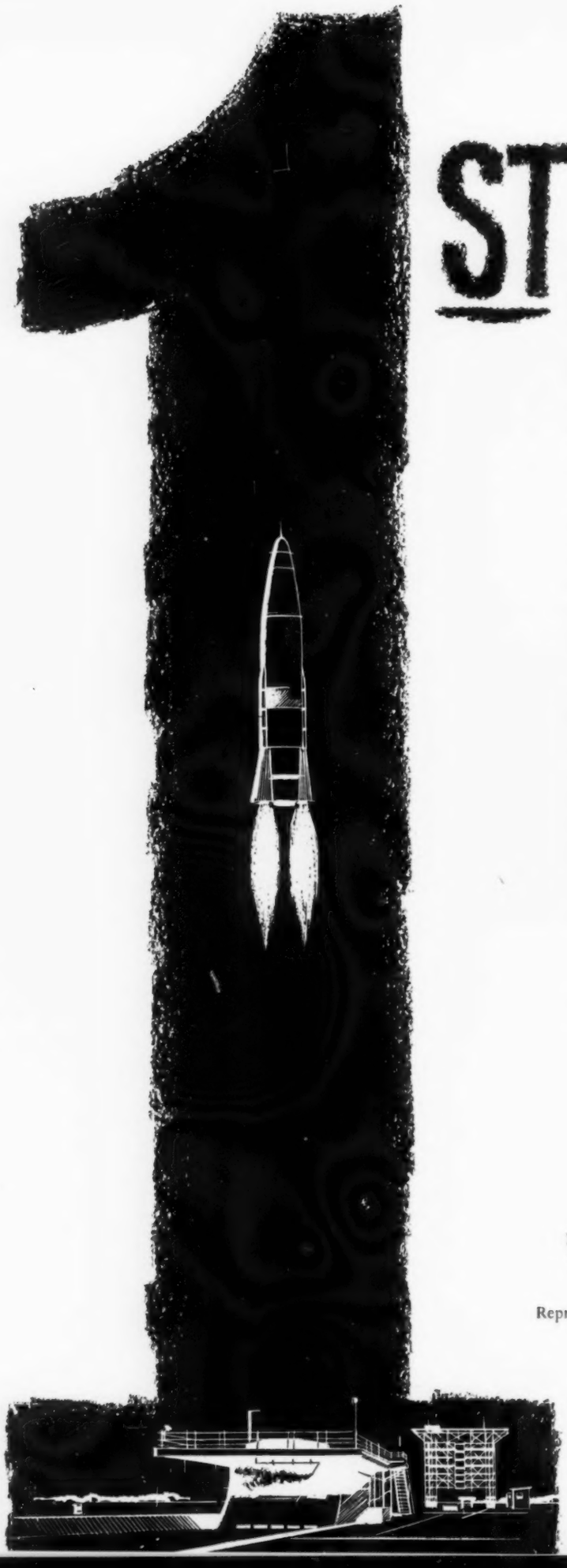
PIPE LINE SERVICE CORP. SERVICE EQUIPMENT MATERIALS FRANKLIN PARK - ILL.

Pipe Line Service Corporation

General Offices and Plant: Franklin Park, Ill.

Quality pioneers in coating and wrapping pipe for a quarter century

A SUBSIDIARY OF AMERICAN STEEL FOUNDRIES

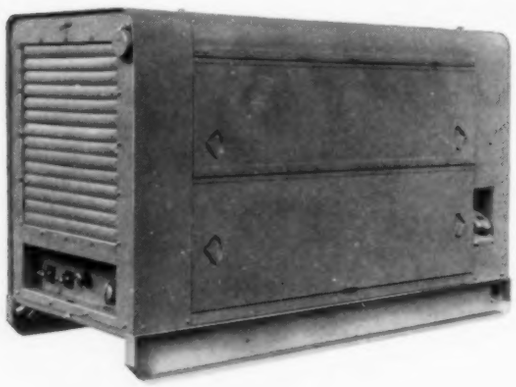


1ST

IN THE FIELD OF "PRECISE POWER" FOR OUR NATION'S ROCKETS AND MISSILES PROGRAM

When you have a power problem . . . and want it solved quickly . . . why not draw *first* on the tried and proved experience of Stewart & Stevenson Services . . . the world's largest distributor of diesel engines.

In our Nation's rockets and missile programs . . . as well as in thousands of commercial applications for the petroleum, industrial and construction industries . . . Stewart & Stevenson experience and "know-how" is paying off in dependable day-in-and-day-out performance. Call, wire or write today.



STEWART & STEVENSON SERVICES, INC.

STEWART & STEVENSON

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Representatives:	Longview, Brownsville, Wichita Falls, Freeport
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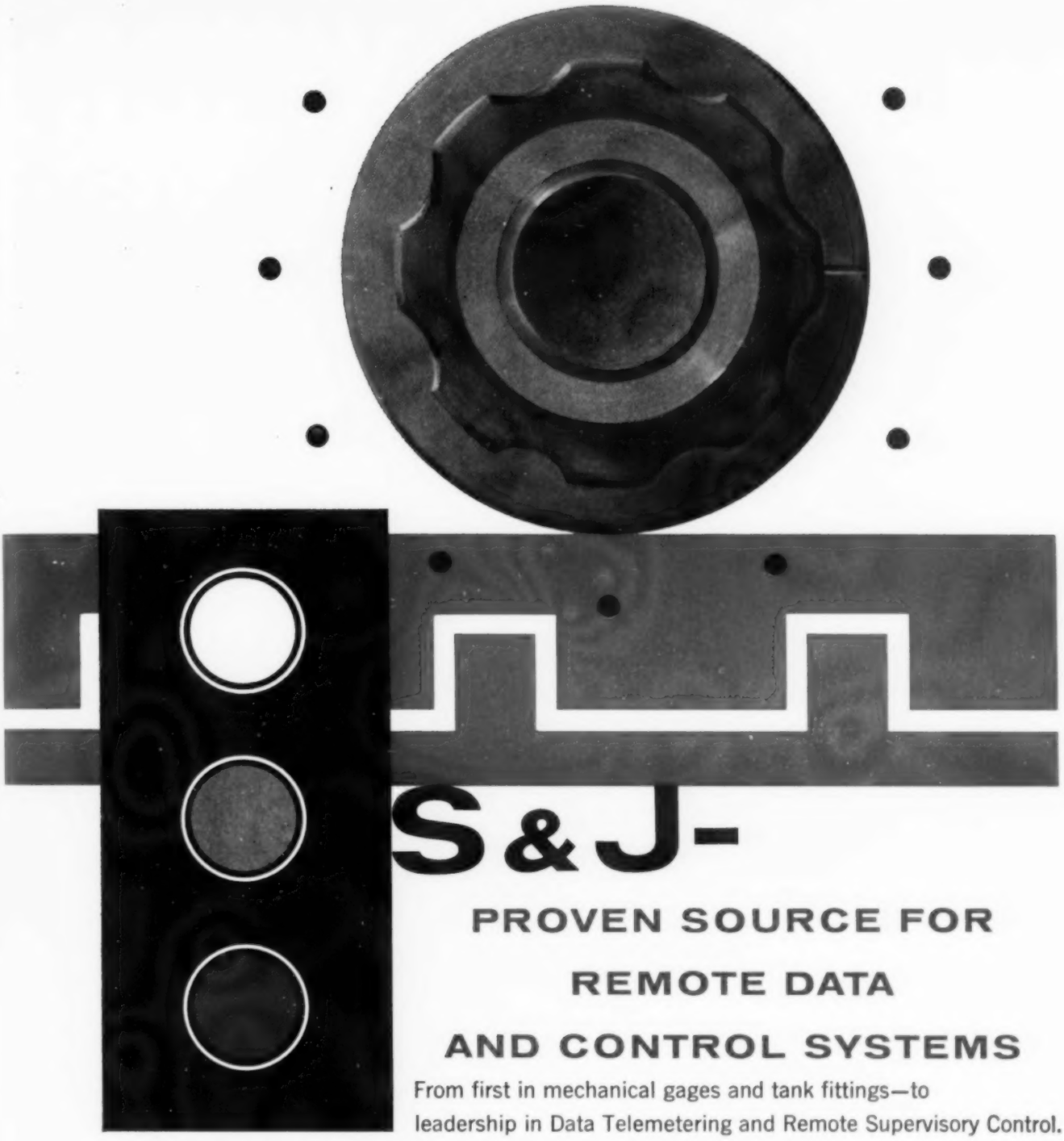
THE WORLD'S LARGEST DISTRIBUTOR OF DIESEL ENGINES



S&J-

PROVEN SOURCE FOR REMOTE DATA AND CONTROL SYSTEMS

From first in mechanical gages and tank fittings—to leadership in Data Telemetering and Remote Supervisory Control.

That's the Shand and Jurs story. Out of our Electrical Products Division comes S&J High Speed Telepulse for telemetering level, temperature, pressure and function control. Proven S&J Gardtrol is serving in remote supervisory control applications throughout the country. And S&J Datalogger presents the latest achievements in tank gaging automation. Remember S&J—the name to know in telemetry and supervisory control.

SHAND AND JURS COMPANY

SHAND AND JURS | A GENERAL PRECISION COMPANY

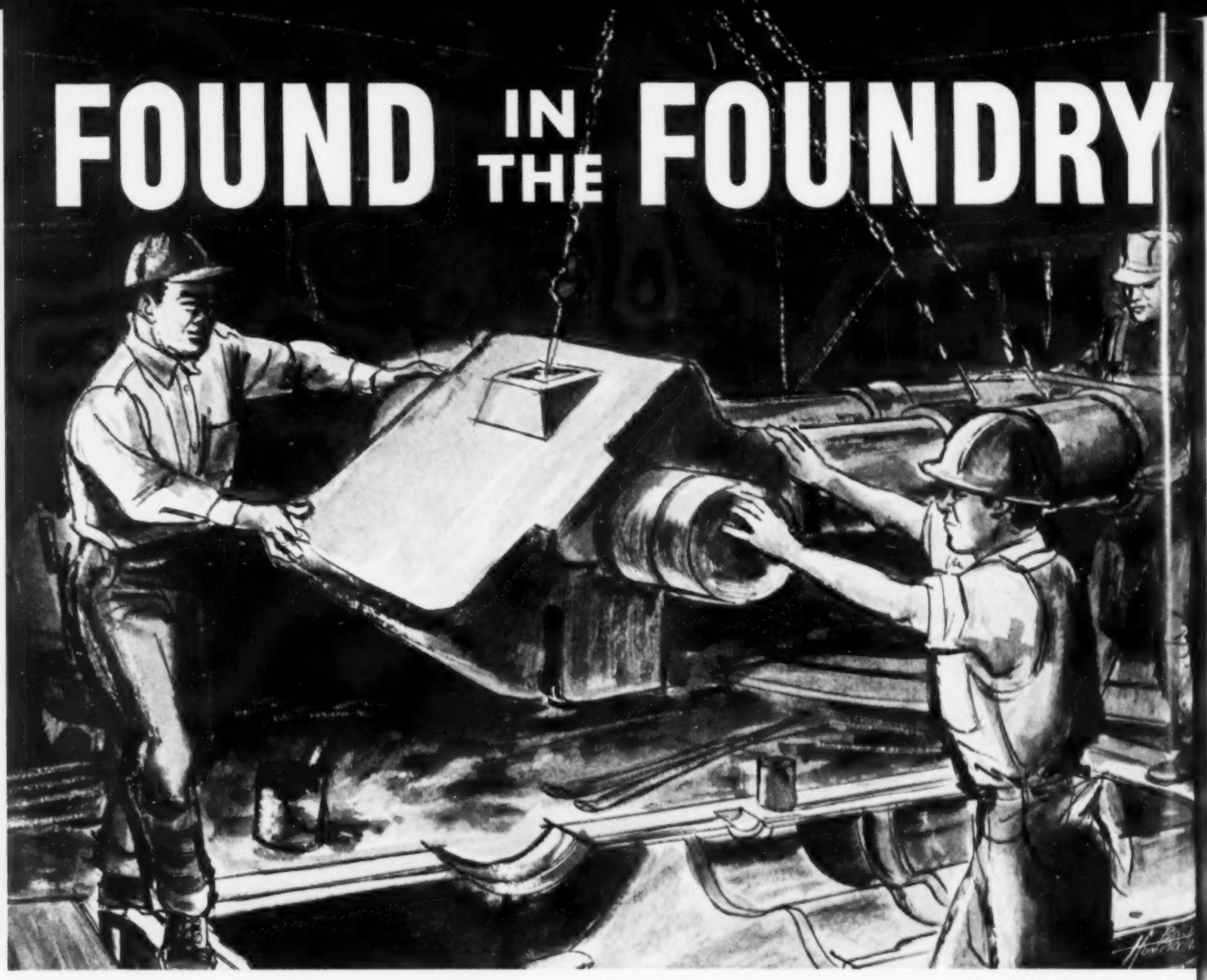
2600 Eighth Street, Berkeley, California

A subsidiary of General Precision Equipment Corporation

5533

For more data on advertised products, use Readers' Service Cards, last page.

FOUND IN THE FOUNDRY



. . . One of the Secrets of GASO'S 44-Year Record of Leadership

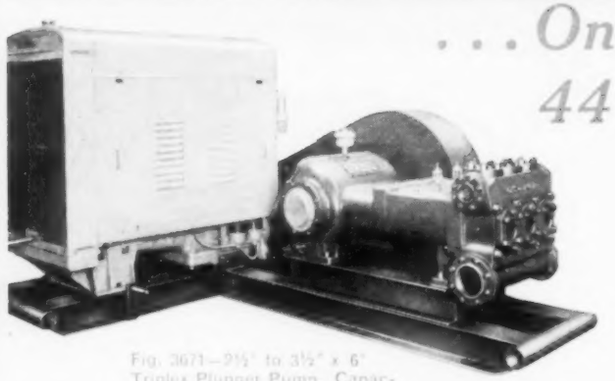


Fig. 3671—2½" to 3½" x 6" Triplex Plunger Pump. Capacities of 191 to 375 barrels per hour at working pressures from 1575 to 800 PSI.

No pump is stronger than the metal from which it is made, and no pump manufacturer casts his metal to more rigid specifications than Gaso. Here experienced foundry-men are preparing the mold for a Gaso power frame. Into it will be poured a special formula of molybdenum alloy cast iron. Test bars, sent regularly to a nationally known laboratory, consistently show a tensile strength of 45,000 to 48,000 lbs. per square inch. Another reason for the ruggedness of Gaso Pumps, their ability to withstand the shocks and strains of tough use, and their habit of outliving ordinary pumps . . . Latest catalog on request.

GASO PUMP & BURNER MFG. CO. • Export Office: Empire State Building, 501 East Fifth Street, Tulsa, Oklahoma — New York, N. Y.

DISTRIBUTORS:

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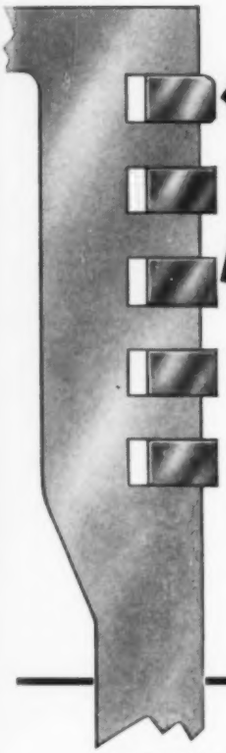
GASO PUMPS
for every oil industry need

100th Anniversary of Oil in America 1959 **44th Anniversary of Gaso Leadership**

ENGINE RING

NEWS YOU CAN USE ABOUT ENGINE AND COMPRESSOR PERFORMANCE

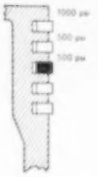


← HAVING TOP RING TROUBLE?

THE SOLUTION MAY BE IN THE THIRD GROOVE — NOT THE FIRST!

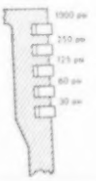
If you've had trouble with your top piston rings (excessive groove wear, groove damage, ring breakage, etc.) you won't need to be convinced that the top ring carries from 50 to 80% of the sealing load. Installing top rings of special, expensive materials is often not the answer. They may be shock-resistant but generally lack adequate wearing qualities. One likely solution is installation of a Cooktite sealing ring in the THIRD groove to relieve the load carried by the first ring. In an engine with a compression pressure of 500 psi and a firing pressure of 1000 psi, a Cooktite ring in the third groove will reduce the pressure differential on the top ring from a trouble-causing 750 psi to an easily-handled 500 psi. Ask a C. Lee Cook representative to explain in detail.

PRESSURE DIFFERENTIAL AT FULL FIRING PRESSURE



WITH COOKTITE SEALING RING IN THIRD GROOVE

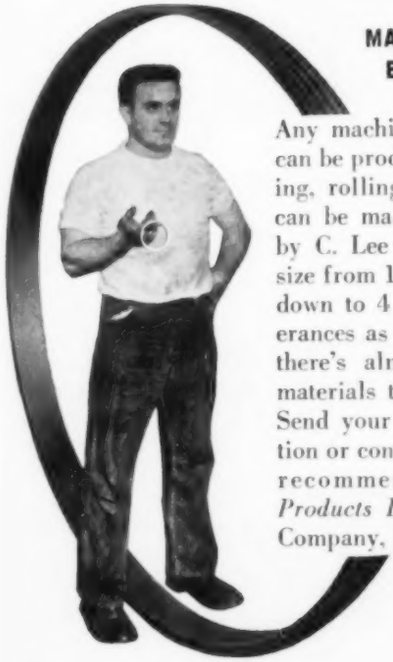
500 psi



WITHOUT COOKTITE RING IN THIRD GROOVE

750 psi

MACHINED ROUND SHAPES FROM ANY MATERIAL



MADE TO YOUR BLUEPRINTS

Any machined round shape that can be produced by turning, milling, rolling, lapping or drilling can be made to your blueprints by C. Lee Cook Company. Any size from 1" to 60", with finishes down to 4 micro-inches and tolerances as close as .0002". And, there's almost no limit to the materials that can be machined. Send your blueprints for quotation or contact us for engineering recommendations. *Airtomic Products Division*, C. Lee Cook Company, Louisville 3, Ky.

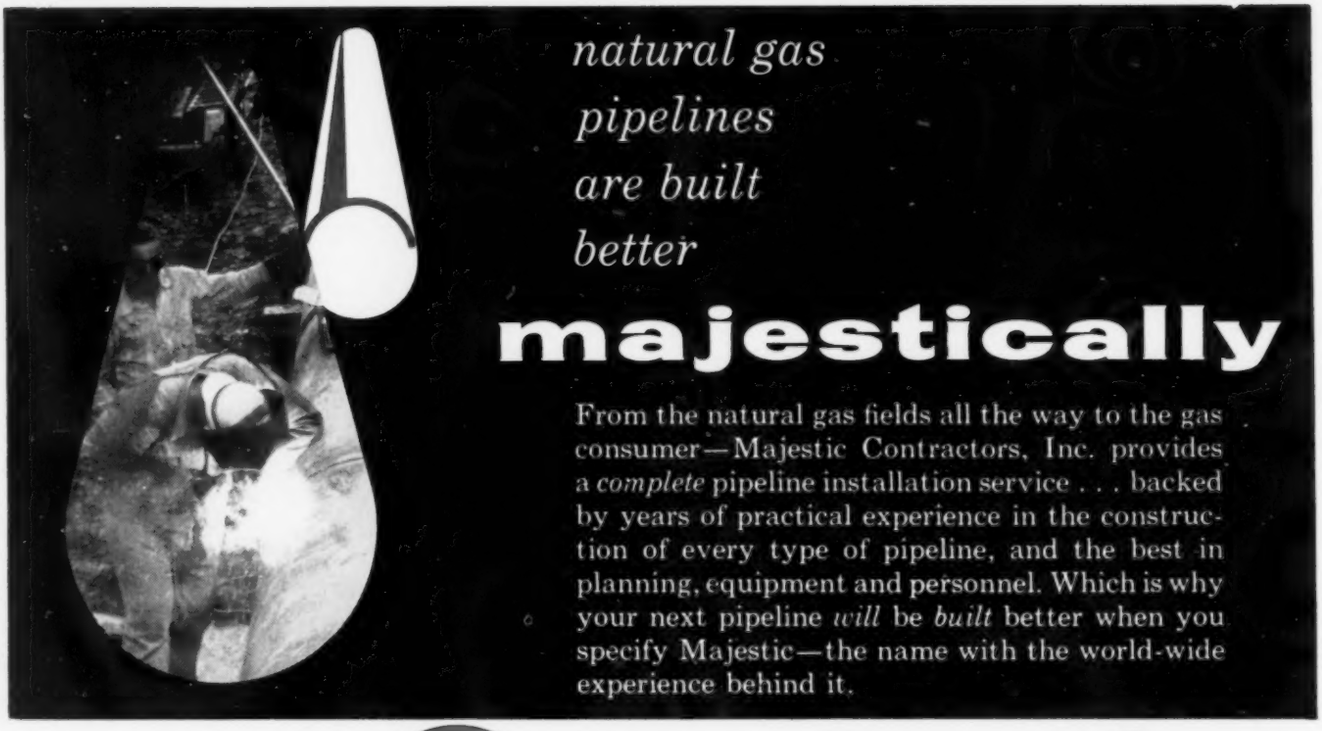
WRITE FOR COOK'S NEW PISTON RING CATALOG

Sixteen-page catalog just off the press. Describes complete line of piston rings manufactured by C. Lee Cook Company, also the special rings of the Airtomics Division. For your free copy, write: C. Lee Cook Company, 911 South 8th Street, Louisville 3, Kentucky.

C. LEE COOK COMPANY

Division of Dover Corporation

Rings and Packings Since 1888



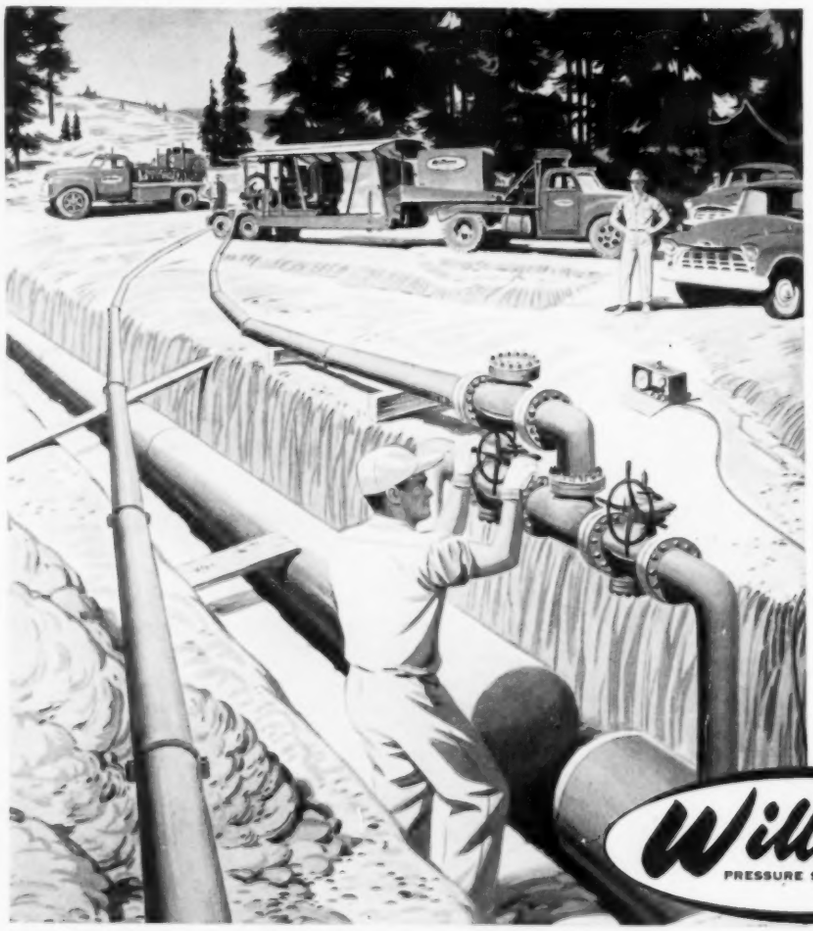
natural gas pipelines are built better

majestically

From the natural gas fields all the way to the gas consumer—Majestic Contractors, Inc. provides a *complete* pipeline installation service . . . backed by years of practical experience in the construction of every type of pipeline, and the best in planning, equipment and personnel. Which is why your next pipeline *will* be *built* better when you specify Majestic—the name with the world-wide experience behind it.

from the field direct to the consumer

majestic
CONTRACTORS, INC.
HEAD OFFICE: 1902 TENNESSEE BUILDING, HOUSTON, TEXAS



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COMPLETE SERVICE

SPECIALLY DEVELOPED EQUIPMENT

EXPERIENCED TESTING ENGINEERS

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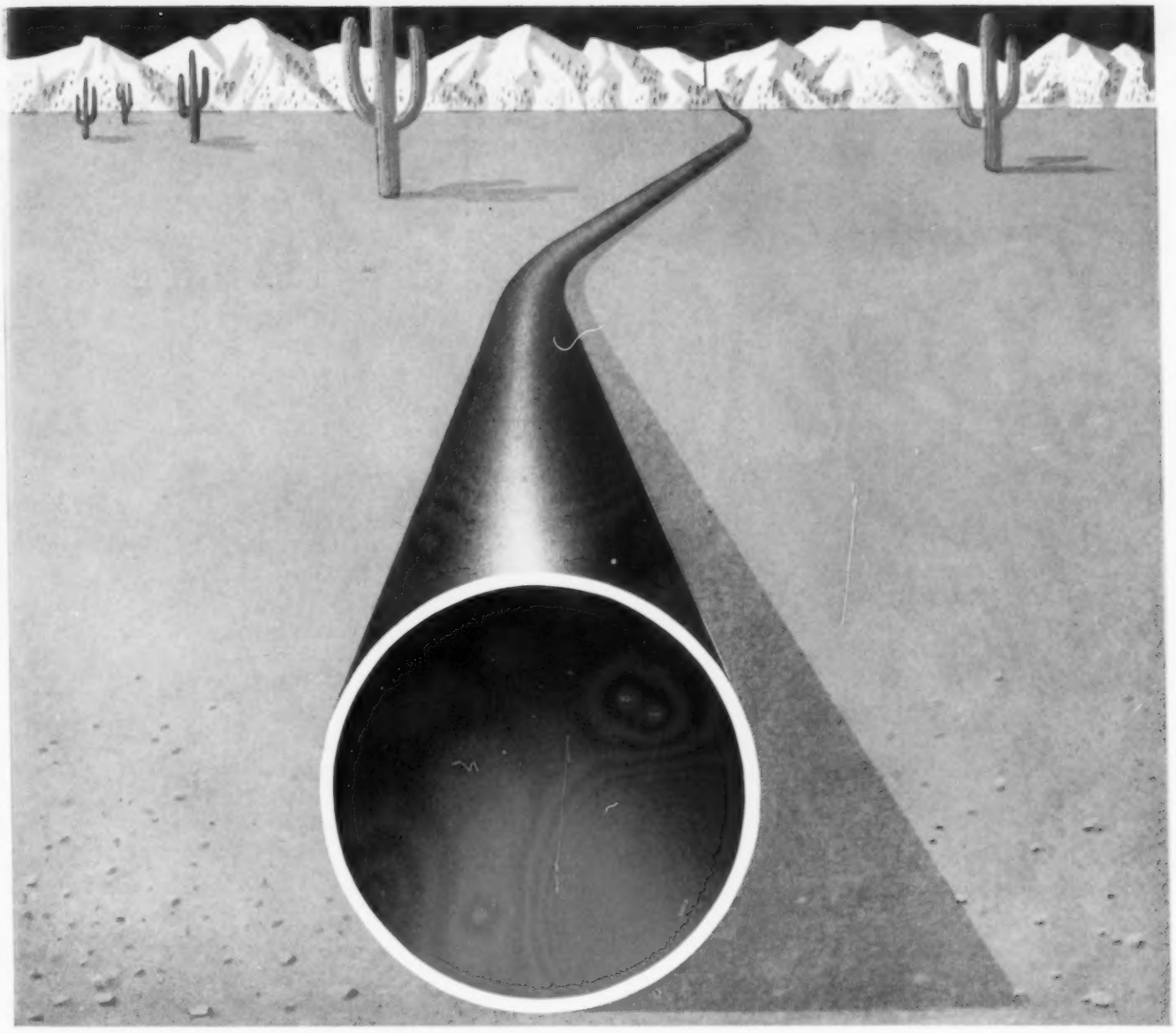


ALLIED CHEMICAL'S HOTLINE ENAMEL

defies 180°F. heat without sliding and −10°F. cold without cracking

Allied Chemical Hotline Enamel's resistance to both high and low temperatures, as well as its greater durability, compared to asphalt base and other coatings, has been proved by laboratory tests, and on-the-job performance for leading public utility companies. Allied Chemical Hotline Enamel is derived from coal-tar pitch, thus possessing inherent protective properties against the damaging effects of water, soil chemicals and electrical currents.

Improves protection under these specific conditions:

1. On pipe-type cables or "oil-o-static lines" which are subject to internal electrical heat from high-voltage surges.

2. Hot gas pipelines, on discharge side of compressor stations where line is above 120°F.

3. Warm, swampy areas or other places where excessive soil stress is encountered.

4. Areas where backfill and trenches are rough, rocky or contain objects which normally penetrate softer coatings.

5. Pipelines (such as heated fuel lines) where temperatures are constantly high most of the time, but do not exceed 180°F. or 200°F. for short term exposure.

A staff of field service experts are at your call to offer you technical assistance that can save you maintenance time and costs. **LAST WORD IN CORROSION PROTECTION.**

PLASTICS AND COAL CHEMICALS DIVISION
40 Rector Street, New York 6, N. Y.

Allied Chemical

For more data on advertised products, use Readers' Service Cards, last page.

HOT WEATHER FASHION SHOW

The Coolest Pipe Lines This Season Will Wear—

REFLECTO

(WHITE)

Nicolet REFLECTO (White) reduces enamel temperature as much as 30°F. This added protection will keep the enamel at a uniform thickness all around the pipe.

Independent research laboratory tests prove that, under controlled surface heat of 140°F. enamel beneath black felt registered 156°F. Enamel beneath REFLECTO (White) registered 126°F. — **a temperature reduction of 30°F.**

In addition, use on many domestic and foreign jobs has proven the worth and versatility of REFLECTO (White) in a great number of applications. Stocking problems have been solved and considerable transportation savings effected.

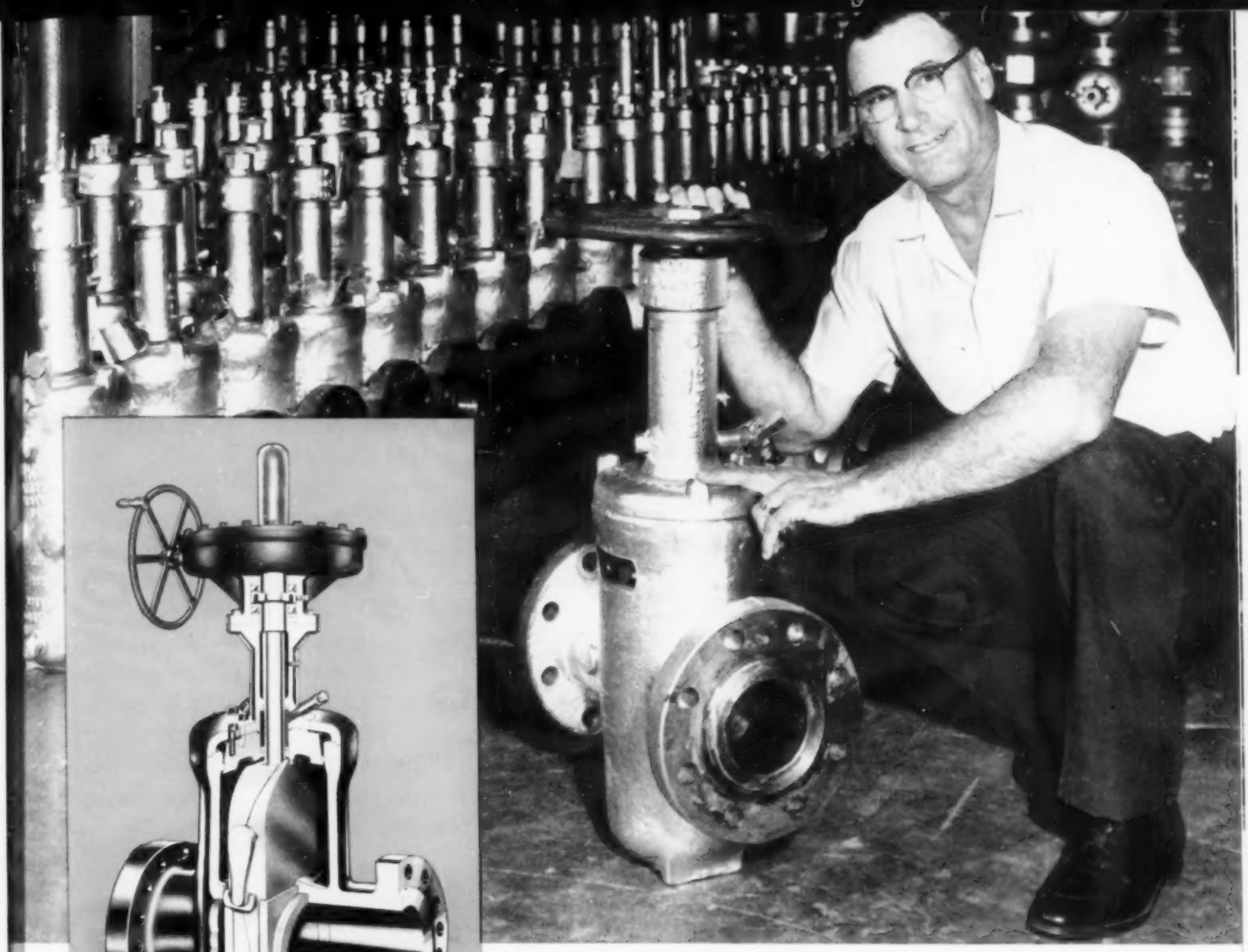
Nicolet REFLECTO (White) weighs 10 lbs. per 100 sq. ft., is reinforced with ¼" spaced parallel glass strands, has Neoprene built right into the sheet — not impregnated or coated — and has a high resistance to scuffing and atmosphere moisture.

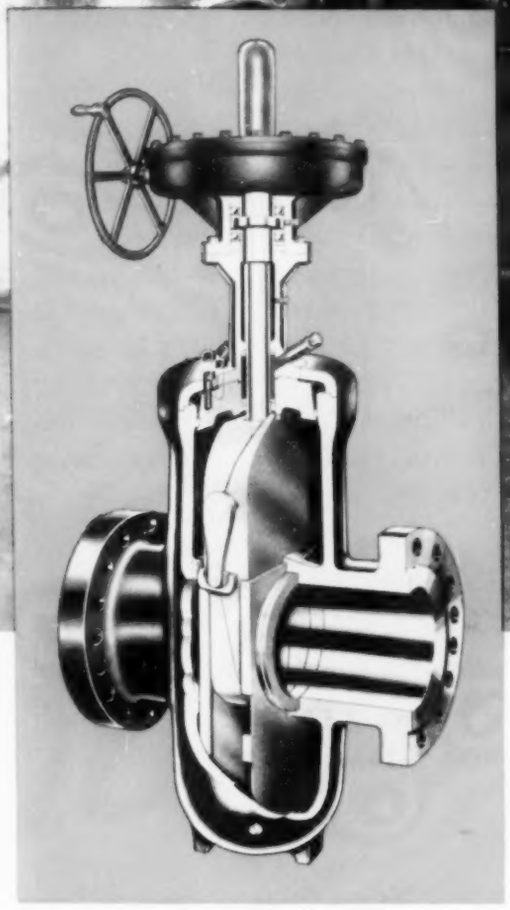
Put REFLECTO (White) to work for you now — it's not too late to specify REFLECTO on this Summer's lines. Write, wire or phone today.

NICOLET INDUSTRIES, INC.
Florham Park, N. J.

Norristown, Pa. Hamilton, Ohio

DISTRIBUTED THROUGHOUT UNITED STATES.





Leverlock* Gate Valves — A W-K-M Exclusive

W-K-M Pipeline Valves open **free** and close **easy** against any pressure within their rating. An exclusive centralizing mechanism—found only in W-K-M Leverlock Valves—positively holds the gate and segment assembly in a retracted position so that it will move freely between the seats when the valve is being opened or closed.

When the gate and segment reach the fully open or fully closed position—and only then—the centralizing mechanism releases to permit the gate and segment to expand and seat tightly against the upstream and downstream seats.

On Hand

Order 2-inch through 12-inch sizes from your supply store. Larger sizes to 34-inch available on special order from factory. Sizes 6-inch and larger are Leverlock Valves. ASA 300 pounds to ASA 1500 pounds.

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The W-K-M® Through-Conduit Gate Valve is your valve

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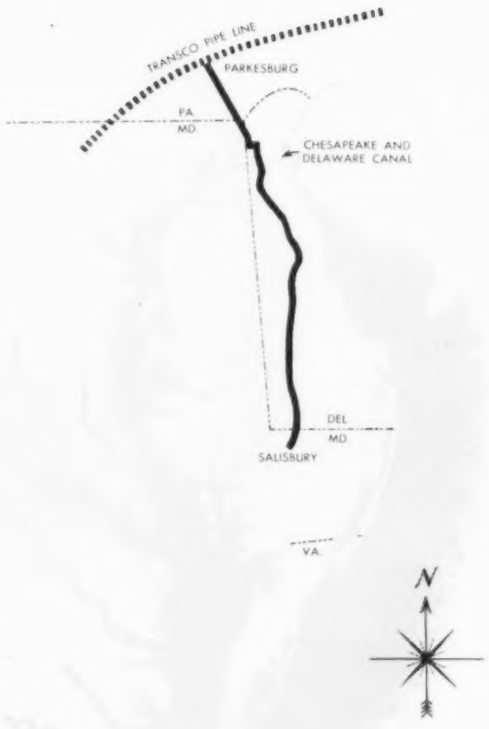
W-K-M SERVING INDUSTRY 40 YEARS

Eastern Shore's New Gas Line



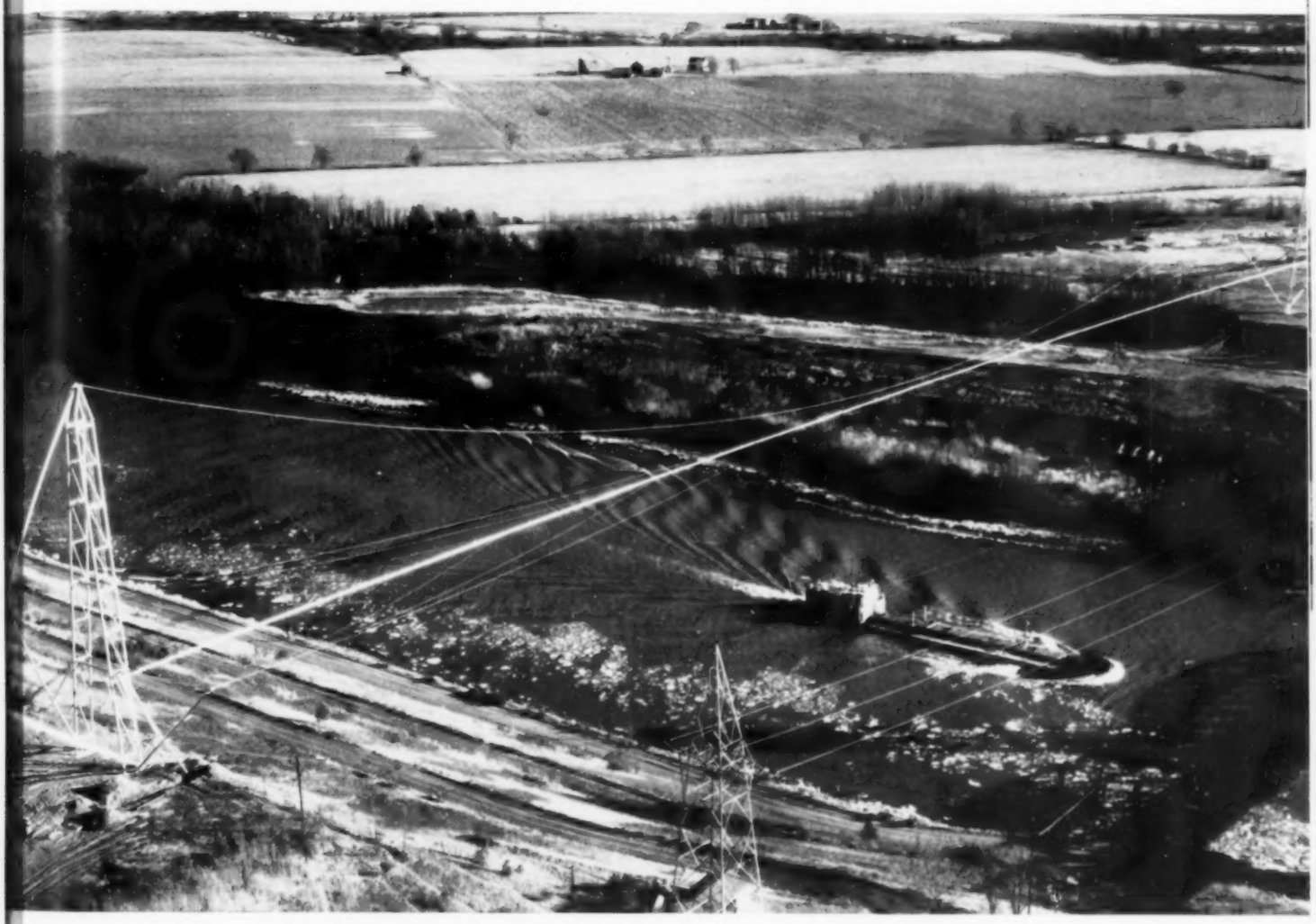
With the erection of this 1280 ft pipeline suspension bridge over the Chesapeake and Delaware Canal near Newark, Del., Eastern Shore Natural Gas Company's new 124-mile pipeline was completed and ready to serve waiting customers. The entire line had been laid and tested prior to the canal crossing, which linked-up the 8⅝-in. OD northern section with the smaller 6⅝-in. OD southern section.

Built with Bethlehem steel pipe—some 5,000 tons of it—the new line taps Transco's main line near Parkesburg, Pa., and runs as far south as Salisbury, Md. The line was installed by Buchanan Pipe Line Company. Over-all advisory services were supplied by Stone & Webster Service Corporation.

Transco's 36-in. OD looping line in southeastern Pennsylvania also required many tons of Bethlehem pipe. Looping along the entire length of the trunk greatly increased Transco's capacity.

Expert handling together with the uniform quality of Bethlehem pipe speeded installation of Eastern Shore's new pipeline. Noland Co., Inc., Washington, D. C., was the jobber.

Leaps 1280 ft Across Canal



Need Line Pipe? Bethlehem makes hydraulically expanded electric fusion-weld pipe from 18-in. through 42-in. OD, in 40-ft lengths; electric resistance-weld pipe from 5 in. (nom.) to 16 in. OD, in lengths to 60 ft; and continuous buttweld pipe ½ in. to 4 in. (nom.) in various lengths. All Bethlehem steel pipe meets the appropriate API specifications.

Contact the nearest Bethlehem Steel sales office for full information. Our engineers will be glad to assist you.

▲ QUARTER-MILE SPAN

Two 50-ton towers, plus strong Bethlehem wire rope and bridge strand, support the 12-in. steel pipe 140-ft above the Chesapeake & Delaware Canal. The structure was designed by Clear Span Engineering Co., Houston, and erected by Midwestern Contractors, Inc., Wheaton, Ill. The tubular steel towers were fabricated by Trinity Steel Company, Dallas, Tex.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

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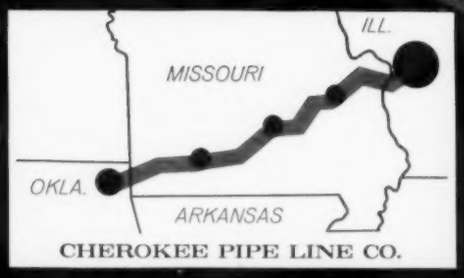
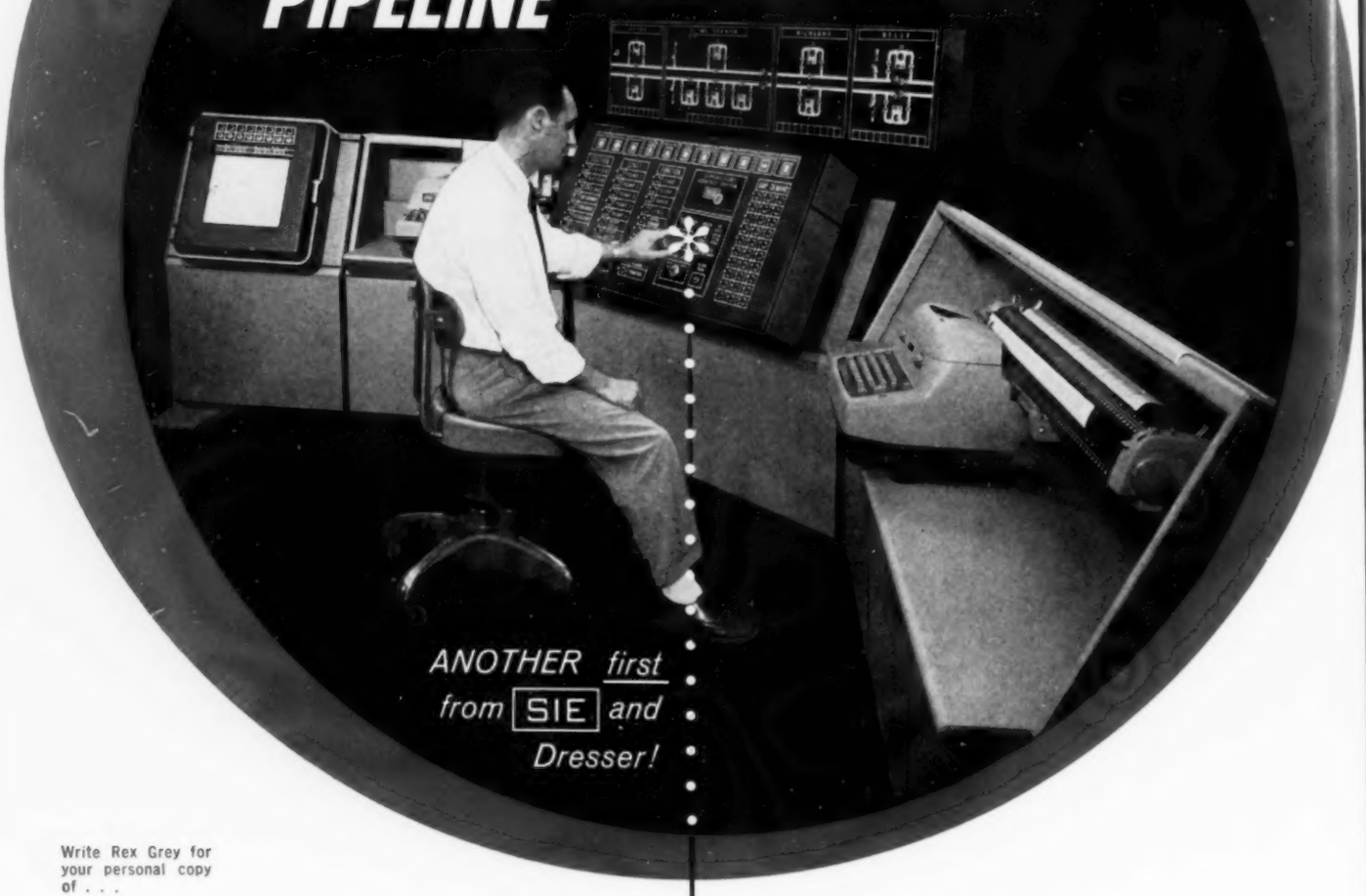
PUSH BUTTON PIPELINE



CHEROKEE PIPE LINE CO.



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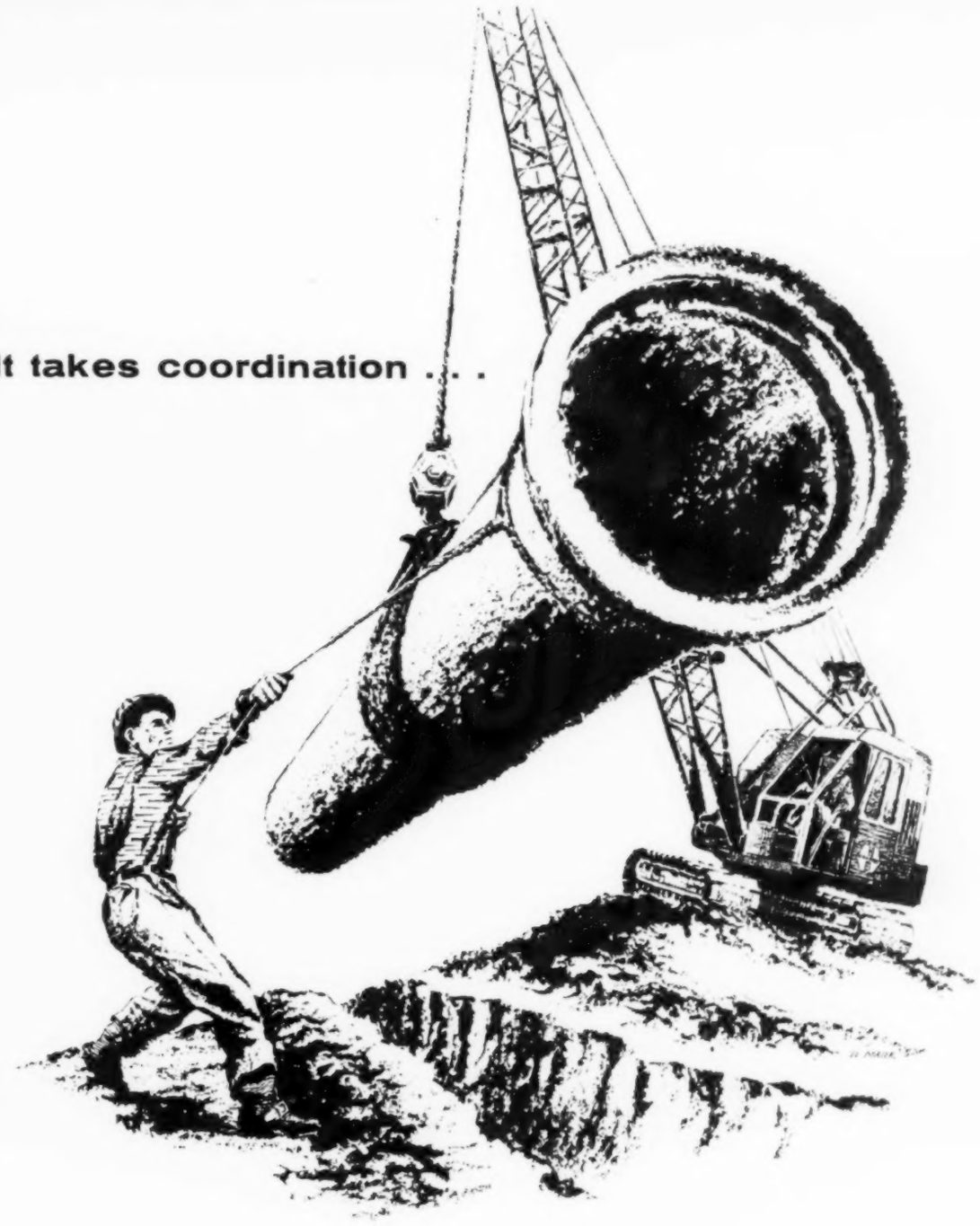

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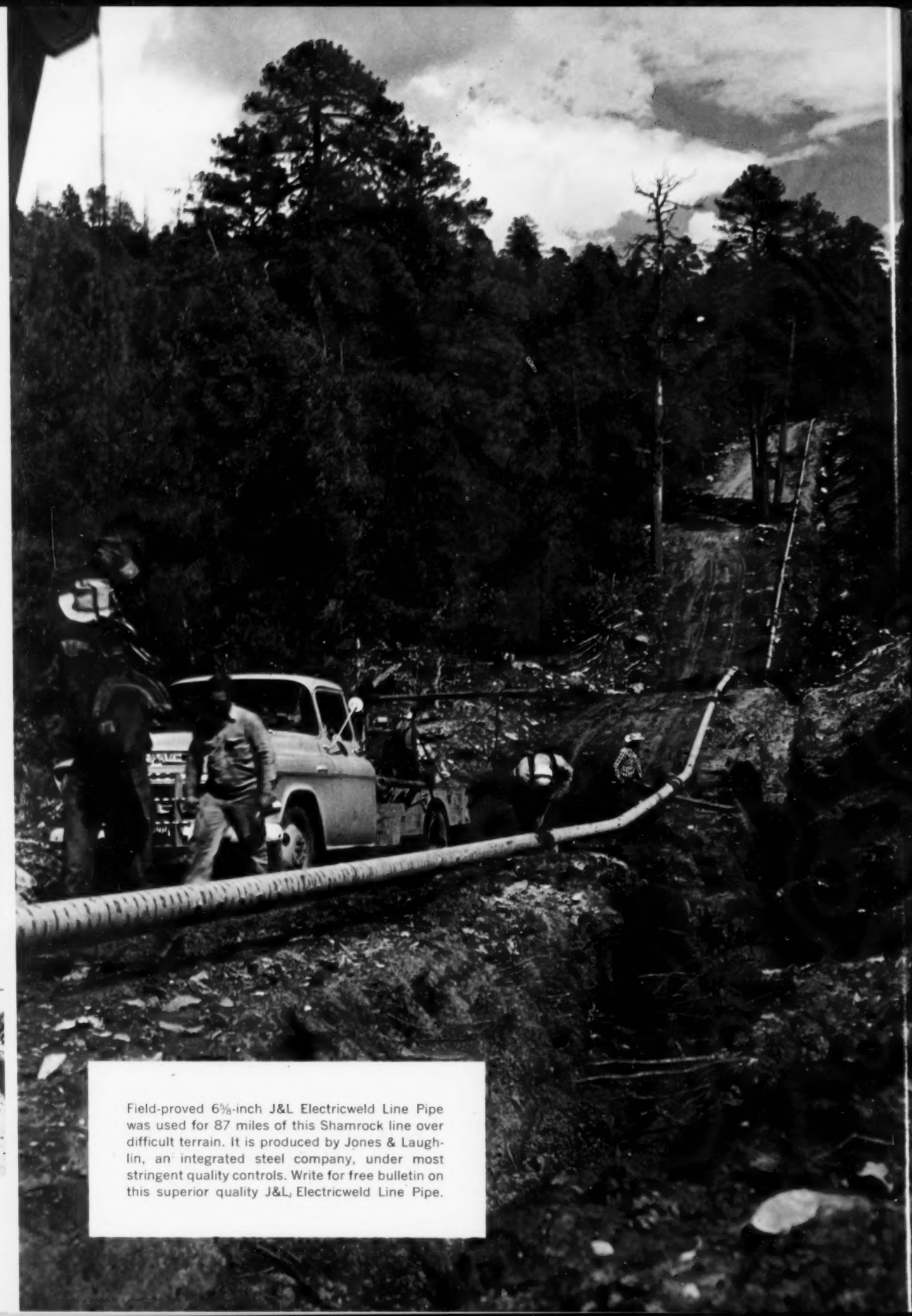
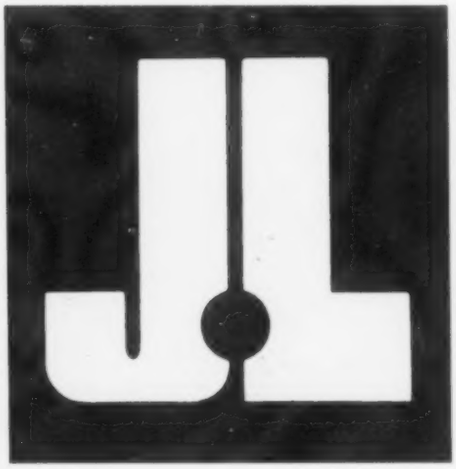


Field-proved 6⅝-inch J&L Electricweld Line Pipe was used for 87 miles of this Shamrock line over difficult terrain. It is produced by Jones & Laughlin, an integrated steel company, under most stringent quality controls. Write for free bulletin on this superior quality J&L Electricweld Line Pipe.

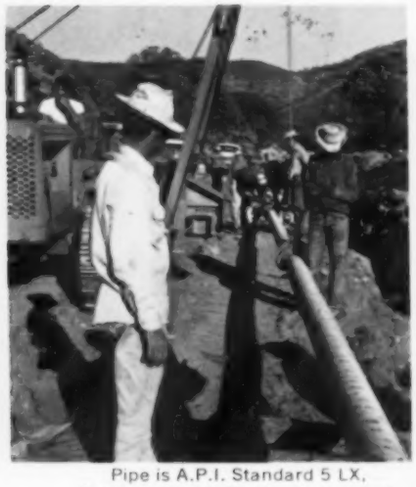
New six-inch products line will be operated by Shamrock for its affiliate, West Emerald Pipe Line Corporation.

Welders on this Shamrock line reported that J&L Electricweld Line Pipe was uniformly round, easy to weld.

Pipe is produced under strict compliance with appropriate A.P.I. and A.S.T.M. specifications.



Contractors for the rugged section from Palma, N.M., to Albuquerque were Groninger & King, Pampa, Texas.



Pipe is A.P.I. Standard 5 LX, Grade X 42, 12.89 pounds per foot, with a .188 inch wall thickness.

"Superior weldability of J&L Electricweld Line Pipe was proved on this mountainous operation"

. . . reports pipe line contractor

Steep, mountainous terrain presented a real challenge to pipeliners working on this Shamrock Oil and Gas Corporation line from Amarillo to Albuquerque. Eighty-seven miles of 6⅝-inch J&L Electricweld Line Pipe were used in the rugged section from Palma, N.M., to Albuquerque. Performance proved conclusively that J&L Electricweld Line Pipe bends readily to contour, is easy to weld and is uniformly round. It is readily available from 6⅝ inches through 12¾ inches.

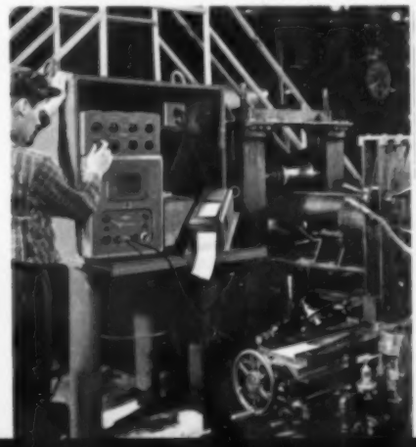
Jones & Laughlin Steel Corporation

PITTSBURGH, PENNSYLVANIA

J&L Electricweld Line Pipe is produced on one of the most modern mills in the world.

Hydrostatic test is one of a series of inspections and tests given every length of pipe.

This modern J&L ultra-sonic tester assures superior weld quality.



CARRIER EQUIPMENT BY STROMBERG-CARLSON

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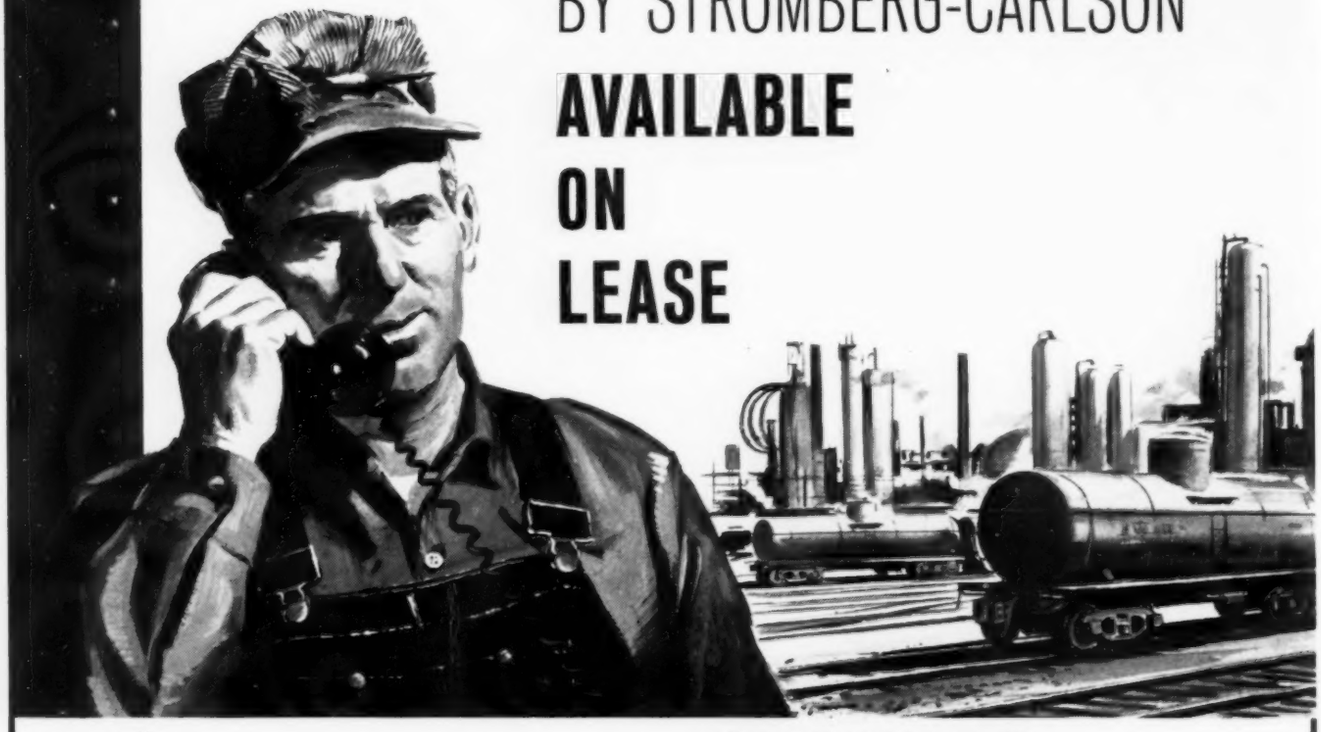
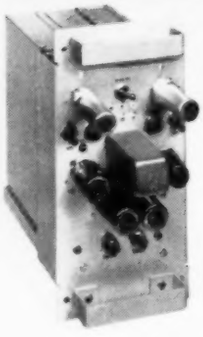
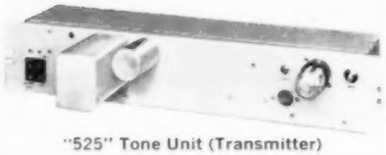


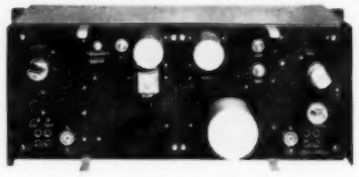


"535" Telegraph Carrier

"524" Tone Unit (Receiver)



"525" Tone Unit (Transmitter)



"531" Telegraph Terminal

"565" Wire Line Carrier

"561" Pole Box Unit

You don't have to tie up capital funds to enjoy the advantages of carrier equipment by Stromberg-Carlson. You may **lease** any equipment you need.

Stromberg-Carlson products in the carrier field include:

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Other telecommunication equipment for your modernization program includes: 100% transistorized negative impedance voice frequency repeaters (series and shunt types); hybrid repeaters; XY® Dial and manual switching systems; 4-wire data and telephone switching equipment.

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PIPE LINE PANORAMA

Why Internal Coating Is Catching On Fast . . . Forty-four page report on study of internal coating in 11.896-mile section of Tennessee Gas Pipe Line's 24-inch line near Refugio, Texas reveals important new facts:

How project was set up: Study was divided into three phases: (1) Section was tested after 10 years of operation. (2) Section was cleaned with two separately run wire brush pigs. Section was tested after cleaning. (3) Section was cleaned and coated. Two wire brush pigs were used in cleaning, then 3,000-gallon slug of methyl-ethyl-ketone was used as detergent. Epoxy coating was then applied to line internally in place. Section was tested after coating.

Result of project: Increased pipe line deliverability about 5-10 percent, depending on rate of flow. There was nearly constant 4 percent increase directly attributable to phase 2, and an additional 1-6 percent resulting directly from phase 3.

Major internal coating users include Transco, which has applied 1,199 miles of epoxy in past four years—**Tennessee Gas Transmission** plans to internally coat about 500 miles of 30-inch line this year— **Northern Natural** coated 85 miles of 16-inch line at the mill last year, just completed coating 65 miles of 16-inch line in place, and plans to coat about 100 miles of 30-inch line before year's end.

Will There Be a Steel Strike? . . . Yes, say top U.S. Labor Department spokesmen. They predict government pressures will not be enough to mend widening rift between labor and management. **Result:** Four to six-week strike, with unions getting at least 10 cents-an-hour wage boost, plus fringe benefits. Increases will be passed on to steel buyers, with predicted 2-5 percent hike in steel prices by summer's end.

Major Projects Get Green Light . . . 1959 pipe line construction finally got off the ground in in mid-May, with FPC approval of two major projects. Tennessee and Midwestern have go ahead to construct long debated 350-mile, 30-inch main line from Portland, Tenn., to Joliet, Ill., and 157 miles of 36-inch loops in Louisiana, Mississippi and Tennessee. Construction will start this month. Cost: $111 million.

Trunkline has approval to start $81 million expansion program, including 204-mile, 24-inch main line extension in Illinois-Indiana; about 500 miles of loops in Texas, Louisiana and Illinois; plus several gathering and lateral lines in Louisiana.

Waiting list includes Northern Natural which is looking for early approval of $100 million-plus program to construct more than 200 miles of main line in Minnesota, Wisconsin, Iowa, South Dakota, Illinois, and Nebraska. And Transwestern is still hoping for approval on 1,800 miles of 24-30-inch line from Texas-Oklahoma panhandles to California. FPC Examiner recommended that $190 million project be rejected on price conditions. However, Transwestern has offered strong rebuttals to counteract objections.

For Those Who Like Oil in Their Cereal . . . Canadian pipe line contractor is experimenting with method to transport wheat in Edmonton-Sarnia pipe line. Tests are being conducted with copper lines, sending wheat through the line mixed with oil. If oil doesn't work, lighter products will be tried. No problem is seen in cleaning products at end of line. Scoffers say wheat will be badly damaged without proper lubricant, and possibly will be ground to powder. Contractor doesn't agree.

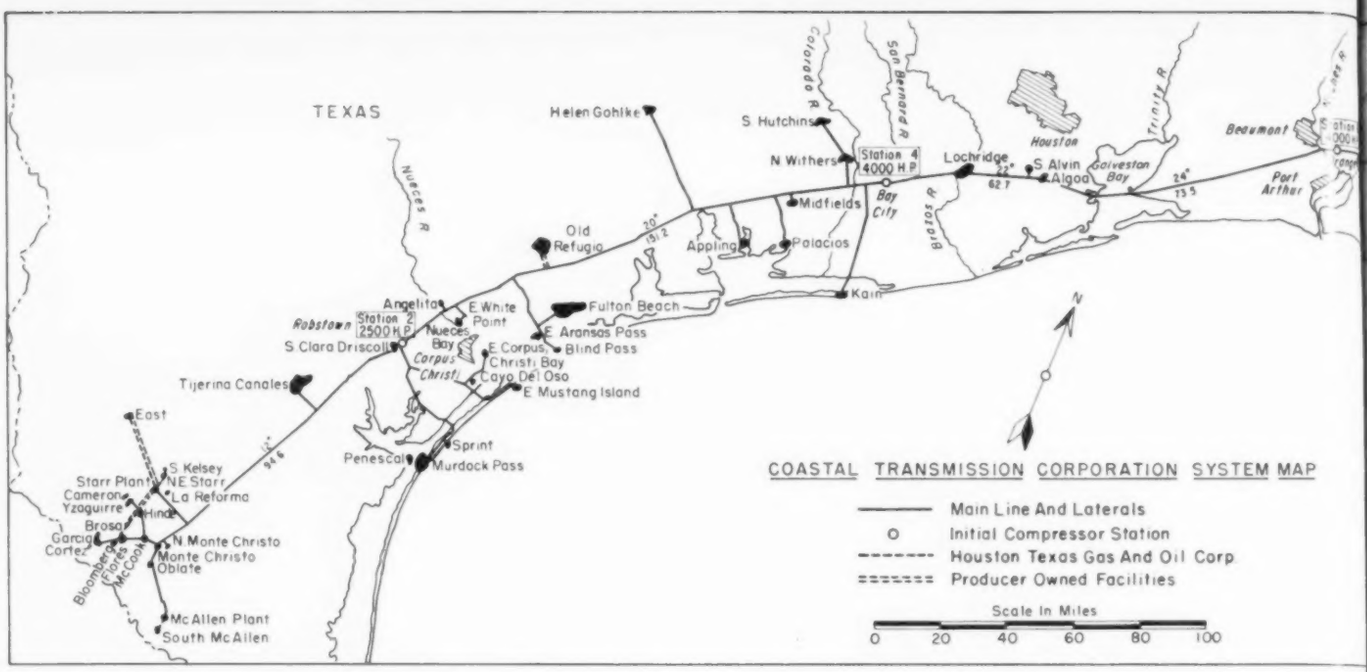


FIGURE 1—System map of Coastal Transmission Corporation's new line. From near McAllen, Texas, to Baton Rouge, Louisiana, it is made up of 561 miles of main line plus 415 miles of supply laterals. All gas transported is delivered to Houston Texas Oil

Coastal Tranmission Combines Proven

To a system of conventional design, engineers and contractors added such new features as fully automatic railhead double-jointing and unitized compressor engine driven auxiliaries

By Melvin A. Judah, Editor
Donald G. De Pugh, Construction Editor

WHEN GAS STARTS moving eastward through Coastal Transmission Corporation's new main line early this month, it will bring to realization a six-year-old dream to deliver Texas and Louisiana gas to Florida. Legal and organizational hurdles were many; so were construction problems. Particularly the unusually heavy rains that slowed work on Coastal spreads to a standstill early in the year. Despite all of these obstacles, the line met its completion and service deadline.

This western segment of the Texas-to-Florida system is made up of some 561 miles of main line plus 415 miles of supply laterals. All gas transported by Coastal is to be delivered to Houston Texas Gas and Oil Corporation at a point east of Baton Rouge, La.

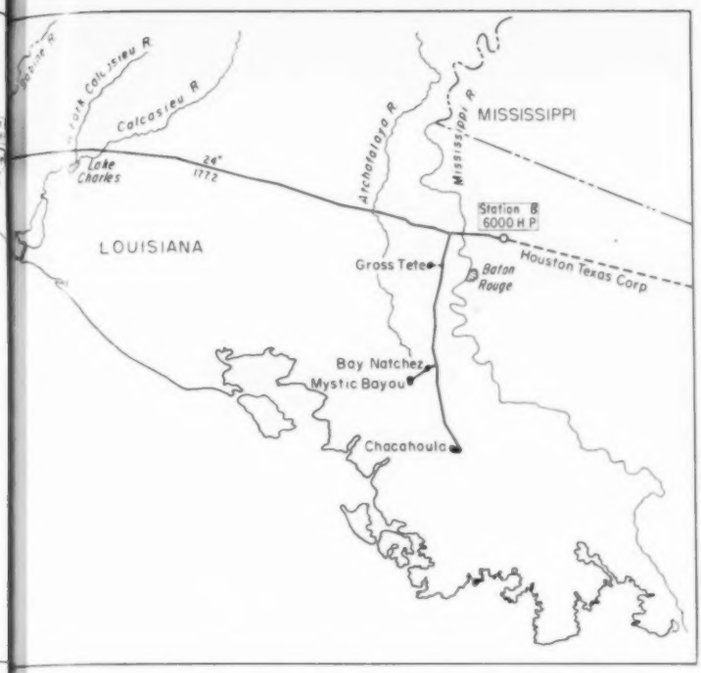
Coastal gathers gas and operates the section from McAllen, Texas, to the delivery point. From there Houston takes gas for delivery to industrial and distribution users throughout Florida.

Between McAllen, near the Mexican border, and Baton Rouge the main line consists of 95 miles of 12-inch, 151 miles of 20-inch, 63 miles of 22-inch, and 252 miles of 24-inch. Diameters of gathering and feeder lines range from 14-inch to 2-inch.

Line Design. Grade API 5LX-52 pipe was used on Coastal's 20, 22 and 24-inch main line. The 12-inch main line was grade X-42; laterals were of various specifications. Except for 79 miles of line in Louisiana which was double-jointed, pipe was supplied in 40-foot joints for field welding.

As seen in the system map, Figure 1, most of the supply laterals are located in Texas. Additional ones in Louisiana include an 80-mile combination of 14, 12 and 6-inch lines to the Chacahoula and Mystic Bayou fields south of Baton Rouge.

Laying Conditions. Extremely heavy rains early in the year caused most of the construction headaches for Coastal's spreads. Otherwise pipe laying progressed well by conventional methods. Light caliche soil was found on some of the right of way in far South Texas. Rippers were used before ditching; little if any blasting was necessary. Some unusual difficulties



and Gas Corporation. Despite delays caused by rains early in the year, contractors met June first completion date.

FIGURE 2—As construction moved toward completion on Coastal's main line, River Construction completes bayou crossing and tie-in near Beaumont, Texas. In the spring, spreads were able to make good progress; however, early in the year most of the right-of-way looked like that shown in the foreground.

Methods with Promising Advances

were experienced in crossing rice fields in South Texas this spring.

New Double-Jointing Method. On 79 miles of Coastal's main line between Lake Charles and Baton Rouge, 40-foot joints were welded into 80-foot sections in a new automatic welding plant. In this new technique, developed by Bechtel Corporation as subcontractor for Oklahoma Contracting Company, the completely automatic weld was made by a submerged-arc process; all welding was done from the outside.

Bechtel's double-jointing machine uses a new line-up clamp having a flexible glass-fiber tape back-up strip fitted over the shoes of the clamp. Copper shoes of the line-up clamp are segmented; they expand to cover the entire circumference of the pipe. The pliable glass-fiber tape is fastened around the shoe to fit the contour of the joint. Use of the strip produces a smooth interior root bead. In addition this fiber-glass sleeve also protects the copper shoe against burning and eliminates the possibility of cold laps or

FIGURE 3—Largest of several water crossings, this 11-mile stretch across Galveston Bay and the Houston Ship Channel was completed by barge methods. A fully loaded tanker moves up the channel. The lay barge worked right up to the west side of the channel; the pipe string was then cut and the channel section pulled by a spud barge on the east side as joints were stove-piped on the lay barge. After completion of the channel crossing, the complete string was welded up.

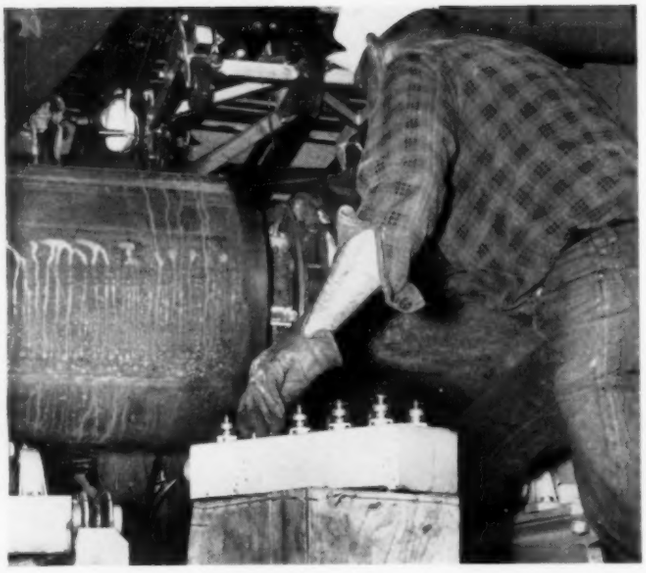


FIGURE 4—Automatic double jointing was used on 79 miles of main line between Lake Charles and Baton Rouge. Here 24-inch joints are lined up; a new line-up clamp having a flexible glass-fiber tape backup strip fitted over the shoes makes it possible to produce a smooth interior root bead using a submerged arc weld from the outside only. Copper shoes of line-up clamp are segmented; they expand to cover entire circumference of the pipe.

FIGURE 5—Ditching across South Texas rice fields. Construction progress was slowed practically to a halt early in the year because of heavy rains but spreads made good progress during the last several weeks of construction. In some areas where rice fields have been flooded, skips caused some delay in completing sections. Through most of the country crossed by the coastal line conditions were ideal once right-of-way had dried out.

notching. A new tape strip is used for each weld.

Another special feature of Bechtel's automatic plant was a "dog-leg compensator" which aligns pipe to allow for vertical or horizontal bends in either joint. Its main function is to assure a fixed spacing at the point of molten weld metal. (See PIPE LINE INDUSTRY—February 1959, Page 38.)

Voltage, amperage, arc-travel and offset are preset to specified pipe diameter, thickness and material. Meters provide a quick visual check for control. While the initial weld is being made, manual removal of the slag allows the cover pass to be deposited without breaking the arc.

Movement of pipe joints was similar to that in other double-jointing plants; however, there is less handling equipment used. Pipe was cleaned by the same methods used in manual welding. All of the double-joint welds were X-rayed at the plant site.

Field Welding. Field welds were made with stringer bead, hot pass, filler and cap. In some instances a strip bead was added where weld metal was not flush with the pipe. Up to 340 welds were made on good construction days. Welding crews consisted of two for the stringer bead, three hot pass, plus six finishing welders.

Specifications called for 20 percent of main line field welds to be X-ray inspected. All welds on water, high-

FIGURE 6—Casing is welded up for road crossing on Panama-Williams spread. Road borings with rice fields on both sides called for special care.

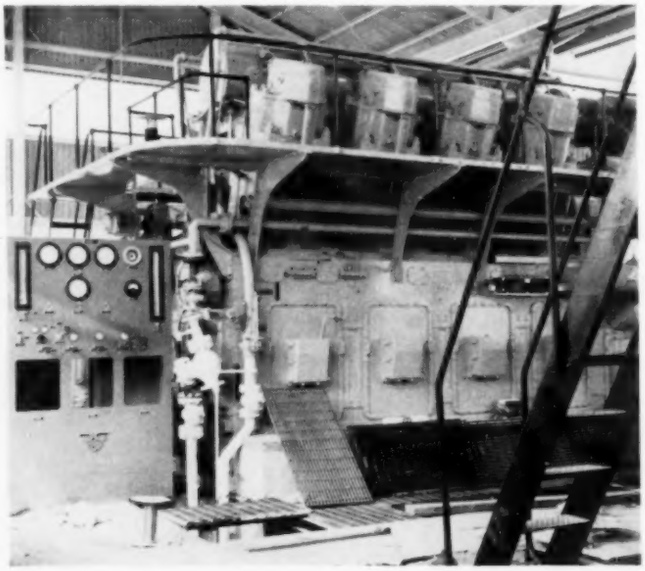


FIGURE 7—Compressors on Coastal's main line are conventional two-cycle angle units rated at 7,350 Btu's per horsepower. Stations are designed for local sequence starting.

way and railroad crossings were X-rayed.

Water Crossings. Rivers, bays and bayous contributed their share of construction problems on the Coastal work. Galveston Bay, the Neches, Atchafalaya and Mississippi rivers were let in separate construction contracts. Main line prime contractors crossed the Colorado, Brazos, Trinity and smaller rivers and bayous. All major river crossings were made with dual buried lines. Several of the supply laterals in South Louisiana were laid by flotation canal pushes.

Pipe used for major river and bay crossings was coated with 2⅛-inch concrete, providing a weight of 230 pounds per foot of 24-inch line. Except for the Mississippi River all crossings were pulled. Dual 24-inch lines across the Mississippi were laid from barges. This crossing was 1.7 miles wide.

Galveston Bay Crossing. The longest water crossing on the Coastal System was made by Brown & Root across Galveston Bay. It was over 11 miles bank to bank, and crossed the busy Houston Ship Channel dredged through the bay.

To lay the 24-inch concrete coated pipe, four lay barges were fitted together giving a 460-foot long pipe workway. Ten work stations were provided; six welding stations, one for X-ray, one cleaning and priming, another for doping, and a final station for applying concrete over the field joint.

To avoid stopping traffic in the Houston Ship Channel, pipe was laid up to the west side of the channel and then cut. Lay barges were towed across the channel, and spudded in; a spud barge with a pulling unit was placed on the west bank of the channel and the pipe string was pulled across as joints were stovepiped on. Pontoons were strapped onto the pipe string to decrease weight of the submerged string during the pull.

Pipe Protection. A 3/32-inch coal tar enamel system was used throughout on the Coastal line. Coating was covered with a 15-pound asbestos felt wrap. For distances 5 miles downstream from each station a glass-fiber wrap was also applied for additional temperature protection. All lateral

Contractors on Coastal Transmission System

Main Line—River Construction Corp., Panama-Williams Corp., Oklahoma Contracting Co., O. R. Burden Construction Corp., Altgelt Construction Co., Ashy Construction Co.

Supply Laterals—Lone-Star Pipe Line Constructors, Barry Construction Co., John Parsons Co., Oklahoma Contracting Co., H. & K. Construction Co., H. S. Shanks and Son, Sam Carline, Inc., Cudd and Burpo.

River and Bay Crossings—Brown & Root, Inc. (Galveston Bay), Buddy Sherrod (Neches River), J. Ray McDermott & Co., Inc. (Mississippi and Atchafalaya Rivers).

Road Crossings—Horizontal Holes, Inc. (sub-contracted for Panama-Williams).

Pipe Stringing—Jess Edwards, Inc., Hunsaker Trucking Co., Archie Lacy, Joe D. Hughes, Cole and Colburn Bros.—Prather Truck Lines.

Pipe Protection—(Coating and wrapping)—Gulf Coast Pipe Coating Corp., Irish Engineering Service, Inc., Syd E. Culbertson Co., Inc. (Weight Coating)—H. C. Price Co., Rosson-Richards, Anchor-Wate Co.

Compressor Station Engineering and Design—Gasoline Plant Construction Corp.

Station Construction—Gasoline Plant Construction Corp., The Early Co., and Tuloma Builders.

FIGURE 8—During good construction weather up to 340 field welds were completed per day. Welding crews consisted of two on the stringer beads, three hot pass, and six finished welders. Minimum of 20 percent of main line field welds were X-rayed.

lines below 12-inch were yard-coated. Design calls for cathodic protection with rectifier units plus magnesium anodes where isolation or other conditions demand.

Pressure Testing. Coastal's main line was hydrostatically tested by company crews to pressures of not less than 1,215 psi. Testing water was filtered before being pumped into the line. After testing lines were pigged and dried with an alcohol slug. On laterals both water and gas were used.

Operating pressure of the main line is to be 975 psi; normal operating pressure on laterals will not exceed 1,000 psi. Tests were made on 20-mile sections unless right-of-way conditions and water supplies required shifts.

Full opening valves were installed at intervals not greater than 20 miles. Crossover and blowdown piping is fitted at each valve.

Compressor Stations. Four compressor stations totaling 16,500 horsepower are installed on the Coastal system. The first station is located at Robstown, Texas, about 115 miles above the southern end of the main line. Here a single 2,500-hp, 10-cylinder engine compressor unit boosts the pressure on the main line. The next station, at Bay City, Texas, has two 2,000-hp, 8-cyclinder reciprocating units installed. Another similar station is located near Beaumont. At Baton Rouge, La., where Coastal delivers to Houston Texas Oil and Gas Corp., three 2,000-hp, 8-cylinder units boost line pressure to 975 psi.

Coastal's units are conventional 2-cycle angle-type engines rated at 7,350 Btu per horsepower hour; they may be turbo-charged for additional power as capacity increases require. Turbocharging of these engines would boost rated horsepower some 40 percent.

Each station has an inlet gas scrubber and a fuel gas scrubber. Dehydration equipment is provided where needed.

As in the design of the Houston station (described in PIPE LINE INDUSTRY May 1959, Page 18) all auxiliaries are unitized with the individual compressor engine. Each engine has its own jacket water pump, lube oil pump, and jacket water cooler. The jacket water pump is belt-driven off the engine flywheel, jacket water passes through a centrifugal pump which acts as a power turbine to drive the fan cooling jacket water and lube oil. The only outside power needed is for station lighting and personnel housing.

Coastal's stations will be attended; however, they are designed for local sequence starting. Each engine has an individual panel board for startup and loading. Panel boards contain recorder controllers and indicators displaying pressures, speed and temperature. A manually operated valve on the panel board actuates suction, discharge, and bypass valves for loading the engine; a master valve operates each of the valves in proper sequence for loading or unloading. A master station panel board contains records for suction and discharge pressures plus suction and discharge temperatures for the station.

The unit panel board also has shutdown devices for low engine oil

The Men Behind Houston

HERE ARE the men who have conceived, designed and constructed the Houston Texas Gas & Oil Corporation and Coastal Transmission Corporation gas system from South Texas to Miami, Florida.

F. E. Stanley, a veteran of 33 years in the pipe line industry, is president and chairman of the parent firm, Houston Corporation. He is also chairman and president of Houston Texas Gas and chairman of Coastal Transmission.

Stanley began his pipe line career in 1925 with Cities Service Gas Company where he became pipe line construction and division superintendent. He was transferred to Natural Gas Pipeline Company of America for construction of the 24-inch line from Texas to Chicago. After serving two years as general superintendent of pipe line construction for Sheehan Pipeline Construction Company, Stanley formed his own firm, Midwestern Constructors, Inc., in 1938. He was active president of Midwestern until financing of Houston was started.

In 1947, Stanley organized the Associated Natural Gas Company and was instrumental in forming the Gulfcoast Northern Gas Company. He was named Tulsa's "Man of the Year" in 1950, having been active in the Chamber of Commerce and other societies in Oklahoma.

Executive vice president and director of Houston Texas Gas & Oil and Coastal Transmission corporations, **Dwight B. Sprow** came to The Houston Corporation from Natural Gas Pipeline Company of America. He had served with NGPL from 1930 until 1958 and had been vice president of operations for NGPL, Texas Illinois Natural Gas Pipeline Company and Natural Gas Storage Company of Illinois prior to joining Houston.

Sprow has served as chairman of the American Gas Association's Transmission Committee and has been on the Advisory Council of the Southern Gas Association the past five years.

W. J. Bowen became president of Coastal Transmission Corporation in 1956 and presently is senior vice president and director of the Houston Corporation and vice president and director of Houston Texas Gas & Oil Corporation. He was a vice president of Coastal since its inception in 1954.

After receiving his B.S. degree from the U.S. Military Academy of West Point, Bowen served in the Corps of Engineers until 1949 when he joined Delhi Oil Corporation. His experience covers oil and gas production, reserve estimation, and design, construction and operation of gas line facilities owned by Delhi Pipeline Corporation.

A registered professional engineer in Texas, he is a member of the AIME.

O. Paul Herzig, director and vice president of engineering for Houston Texas Gas & Oil Corporation since 1955, is also vice president, engineer-1955, is also vice president of Coastal Transmission.

For the past 24 years, Herzig has been associated with the oil and gas industry as a pipe line engineer on the

pressure, high jacket water temperature, and engine overspeed. Indicators would show the operator the cause of an engine shutdown.

Block valves on station suction are tied into the emergency shutdown system and also to the emergency relief valves. Emergency relief valves also operate as emergency blowdown valves.

Onstream Pigging. Pig launching and receiving equipment will facilitate line cleaning in operation of the Coastal main line. A pig launcher is installed at Robstown station; receivers and launchers at Bay City and Beaumont plus a receiver at Baton Rouge will permit onstream pigging of the line. There will be no pigging on the Houston, Texas section of the line; no additional gas suppiles will be picked up east of Baton Rouge.

Future Expansion. Coastal has already placed a request before the FPC for authority to expand its system to a capacity of 335 million cubic feet per day. Initial capacity of the system is now 275 million cubic feet per day.

New facilities sought by Coastal consist of both compressor horsepower additions and supply laterals costing $6.25 million. This would be the first of a series of expansion steps planned for the next few years. Following approval Coastal would be purchasing gas from 60 gas fields along the Texas and Louisiaina Gulf Coast.—**The End**

Corporation

design, economic study and supervision of construction of some 6,000 miles of pipe line. He formerly was associated with Creole Petroleum Corporation, Mideast Pipeline Company, Imperial Oil and Lakehead Pipe Line Company.

G. B. Bennett is director and vice president, sales and supply, for Houston Texas Gas & Oil Corporation and vice president, operations and sales, of Houston Corporation.

He had been with Sun Oil Company from 1942 to 1958. As division superintendent with Sun, he supervised negotiations and administration of gas plant products sales and purchase agreements.

Vice president, comptroller and assistant secretary of Houston Corporation and Houston Texas Gas & Oil, and vice president, comptroller of Coastal Transmission, **E. P. Shanahan** joined the firm in 1958.

From 1940 to 1958, Shanahan had been with Price Waterhouse Company where he advanced to position of manager of accounting staff in the New York Office.

Stanley Sprow Bowen Herzig Bennett

Shanahan Rolfe Hoss Zachry Hardesty

Kienast Campbell Cramer Wilhite Payne

Eldon C. Rolfe, chief engineer of Houston Texas Gas & Oil Corporation, has had extensive activity in pipe line construction and operations. He served with H. L. Gentry Engineering Company as superintendent of pipe line construction and later worked for Natural Gas Pipeline Company as resident engineer on compressor stations. He also has been associated with Walco Engineering and Construction Company, and Midwestern Constructors, Inc.

James M. Hoss, Jr., chief engineer of Coastal Transmission Corporation, joined the company in 1958. Previously he had been with Texas Eastern Transmission Corporation as assistant to the superintendent of compressor stations. From 1953 to 1958, he had been district superintendent for Gulf Interstate Gas Company.

J. B. Zachry is the superintendent of compression for Houston Texas Gas & Oil and Coastal Transmission. For the past 23 years Zachry was with Worthington Corporation where he worked as erector, test and research engineer, installation and operation of gas engine compressors, power units and diesel engines. Since 1949, he had been a special representative serving the transmission lines in the southwest.

D. A. Hardesty, superintendent of pipe lines for Houston Texas and Coastal Transmission, has had nearly 30 years experience in the gas industry. He joined Natural Gas Pipeline Company for testing of their original line from Texas to Chicago and remained with the company until 1958.

He served as vice president of

Continued on Page 67

A SPECIAL

PIPE LINE FEATURE

Using Expandable Spheroids For Batch Separation

On Shell's Wood River-Chicago products line, engineers have reduced interfacial mixing to one-third of former values using spheroids The cost is low

By M. L. Barrett, Jr.
Shell Oil Company, Indianapolis

SHELL OIL COMPANY has been working toward the development of full-scale batch separation for its 14-inch 250-mile-long Wood River-to-Chicago products line. The most promising method thus far devised employs expandable spheroids, which are able to maintain their relative position in the products stream as it moves down the pipe line, past pump stations and on to delivery points.

Mechanical Separator. Several years back, Shell investigated the separation of fluids in its 8-inch products line. Results showed that one scraper per interface could appreciably reduce the normal spread of an interface, but a number of well spaced scrapers could effect even better separation.

As a result, a procedure was evolved wherein liquid buffer tenders are employed as usual; but in addition, one double-disc type separator scraper is used at each end of an interfacial mixture where the protected products are not compatible. If two such scrapers are properly spaced and located at an interface they have the ability to reduce an interfacial volume at destination to about 75 to 80 percent of its unprotected volume. This two-scraper system of interface protection is still being used in several of Shell's lines today.

Disadvantages of Disc-Type Separators. Some of the primary disadvantages are:

1. Insufficient protection against mixing because the number of scrapers that can be used is dependent upon the scraper barrels.

2. Rubber wear is high and expensive.

3. Labor charges for handling and maintaining scrapers are high.

4. Scrapers have relatively short life.

5. Mechanical and control difficulties are encountered in the manipulation of scrapers through pump stations along the line.

Eliminating Some of These Disadvantages. One means of overcoming some of these disadvantages listed above appears to be the elastic spheroid-type separator. It has certainly proved effective in Shell's 14-inch Wood River line.

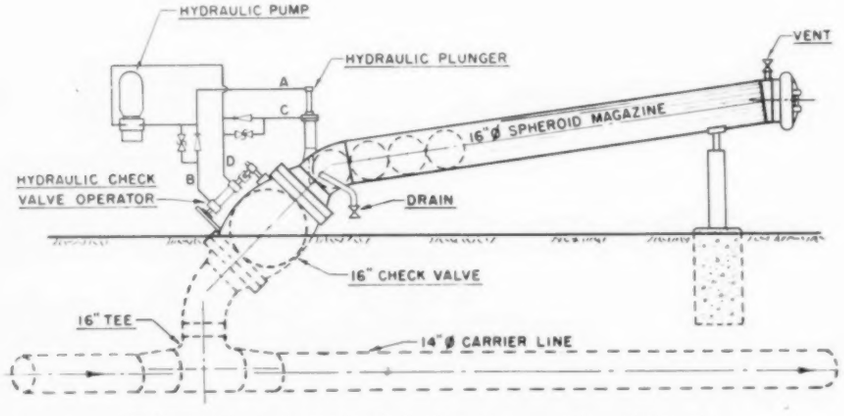


FIGURE 1—Schematic of check valve type spheroid launcher.

The Technique of Spheroidal Separation. The encouraging results of this work with spheroids have led to the establishment of what appears to be a sound commercial technique for minimizing and controlling interfacial mixture generation in long lines. In concept, this essentially involves (1) the bracketing of an originating volume of interfacial mixture between two incompatible fluids by the critical placement of the desired number of spheroids and (2) the movement of those spheroids (or substitutes) in that same relative position in the fluid stream to the end of the pipe line. There are critical elements in both instances. For this reason, it was necessary to develop accurate high speed hand sampling procedures, to test a number of types of spheroids and schemes of placement, and to design and construct the special types of spheroid launching and handling equipment.

Description of Spheroid. Although experimental spheroids have been made with solid cores (aluminum and wood)—spheroids used now are made of two hemispheres of molded elastomer vulcanized into a hollow, expandable sphere. Natural rubber and a number of synthetics ranging in hardnesses from 45 to 65 durometers, have been used experimentally. Neoprene in the 45 to 50 range appears to be the best for long line service where wetting is intermittent. Our work included 8, 12, 14 and 16-inch spheroids—using 14-inch most extensively. The latter has a wall thickness of 2¼ inches, and before using, air is voided from the sphere and it is pumped full of water (or ethylene glycol if necessary). There is a small filling valve recessed in the wall of the spheroid. This filling must be done carefully if the spheroid

s to retain a correct diameter under variable pipe line pressures.

Effect of Spheroid Diameters on Fluid Separation. The relationship of the minor diameter of a spheroid (measured at atmospheric pressure) to the inside pipe line diameter is critical. Figure 2 shows the results of tests of varying sizes of spheroids in a 13⅜ inch I.D. pipe line made by noting the change in a positive displacement meter's factor at the end of a one mile uni-directional displacement meter prover. All tests on Curve 1 were made in the same batch of furnace oil at a 2,600-bhp flow rate.

If we visualize a sphere the size of a golf ball traveling with the flowing stream, sizable volumes of the fluid will bypass it. As the size of the sphere is increased, the area exposed to the velocity forces increases until a diameter is reached where the velocity of the sphere is equal to the mean velocity of the stream for a given set of conditions. This occurs in Figure 2, Curve 1 at a spheroid diameter of just over 9½ inches and there is equal "flow forward" and flow back."

Above this diameter "flow back" increases to a maximum of about 3¾ inches around 11½ inches diameter. Continued enlargement of the spheroid closes down the "flow back" interstice until the condition of mechanical seal is effected at 13⅜ inches diameter and a squeegeeing action is existent. At about 1 percent larger than this diameter a full and effective mechanical wiping action by the spheroid is obtained and any further increase in the spheroid diameter serves no useful purpose.

Indications are, from sampling long line intermix spread, that the "flow back" across a spheroid inflated to the optimum diameter of about 1 percent larger than the pipe I.D. is in the order of 0.02-0.04 percent of the total volume displaced. Thus the "flow back" from front to rear of a properly sized spheroid is minimized but it can never be eliminated.

Observing Figure 2 again, it can be seen that it is necessary to expand all spheroids used to protect an interface to the optimum diameter, for if one of a series is too small it will eventually move downstream until it is "back-to-back" with its downstream neighbor. Similarily, if all the spheroids used to protect an interface do not have the same wear and/or swell characteristics

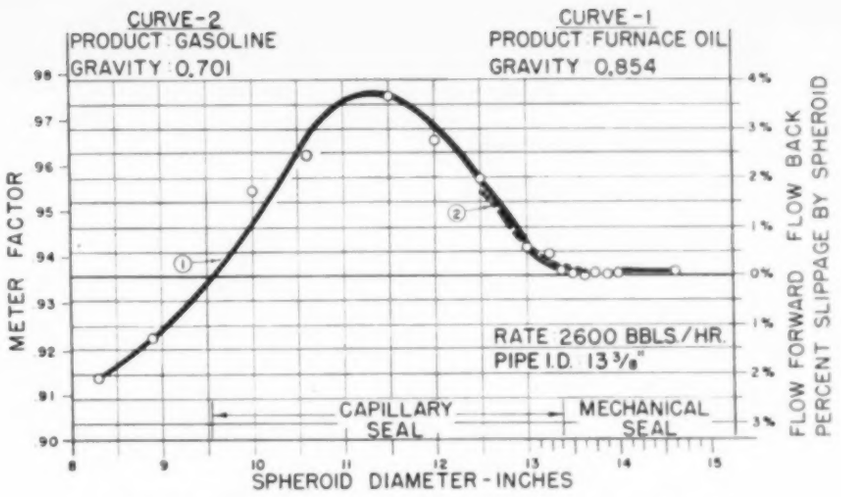


FIGURE 2—Slippage of product past a spheroid of varying size.

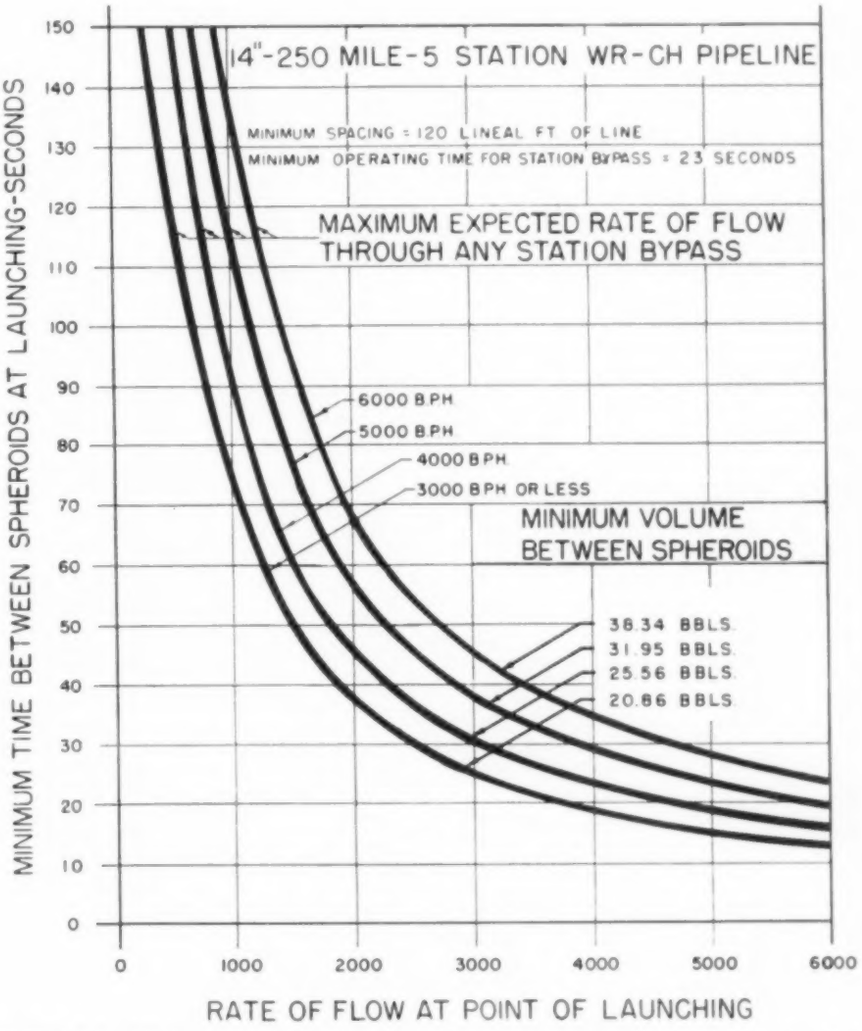

14"-250 MILE-5 STATION WR-CH PIPELINE
MINIMUM SPACING = 120 LINEAL FT. OF LINE
MINIMUM OPERATING TIME FOR STATION BYPASS = 23 SECONDS
MAXIMUM EXPECTED RATE OF FLOW THROUGH ANY STATION BYPASS
6000 B.P.H.
5000 B.P.H.
4000 B.P.H.
3000 B.P.H. OR LESS
MINIMUM VOLUME BETWEEN SPHEROIDS
38.34 BBLS.
31.95 BBLS.
25.56 BBLS.
20.86 BBLS.
MINIMUM TIME BETWEEN SPHEROIDS AT LAUNCHING-SECONDS
RATE OF FLOW AT POINT OF LAUNCHING

FIGURE 3—Minimum spheroid launching spacing at the source of a 14-inch pipe line.

they may sooner or later lose their relative positions in the stream.

Effect of Spheroid Spacing on Fluid Separation. In turbulent flow, without mechanical separators, liquid near the center of the pipe tends to flow faster than liquid near the pipe wall. Thus there is both forward and backward longitudinal diffusion of liquid with respect to the mean velocity or average forward movement of the interface. But at the same time there is radial velocity resulting in turbulent

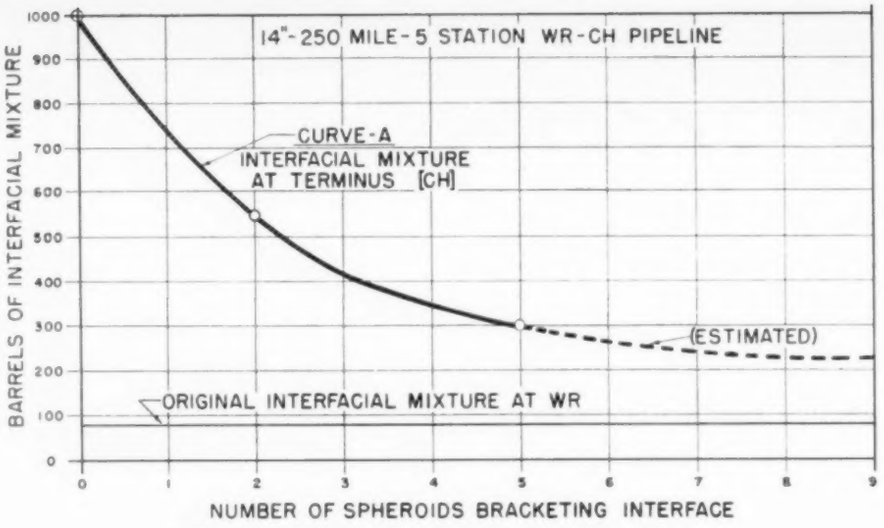


FIGURE 4—Interfacial mixture vs. number of spheroids.

diffusion which decreases the rate of longitudinal intermixing.

It was discovered that by inserting a multiplicity of tightly sealing mechanical barriers an optimum distance apart, starting at the beginning of an interface, the normal flow pattern described above could be changed so that substantially a uniform cross section of velocity could be maintained and forward diffusion was eliminated because there can be only a "flow back" condition across each mechanical barrier of a spheroidal nature. The thin sheath of "flow back" fluid is slowly absorbed by turbulent diffusion behind a spheroid but this requires a definite travel distance for this action to restore radial uniformity of mixture blend. Based on this observation, the point at which radial uniformity of mixture is re-established behind a spheroid was found.

By inserting additional spheroids successively at that point until the last spheroid was inserted in liquid radially uniform with the following pure liquid, the maximum possible reduction of mixing was effected. This minimum spheroidal barrier spacing is extremely critical for a particular pipe line and is no doubt influenced by certain variables such as the relative viscosities of the facing liquids, the pipe line "C" factor, etc.

But for practical commercial purposes this optimum spacing between spheroids in Shell's 14-inch, 250-mile products line has been found to be approximately 120 lineal feet of line for the particular products handled. However, this theoretical optimum spacing of spheroids in an interfacial mixture at the source of a pipe line may be influenced by practical and financial considerations which may dictate that spheroids be spaced at intervals greater than the optimum spacing.

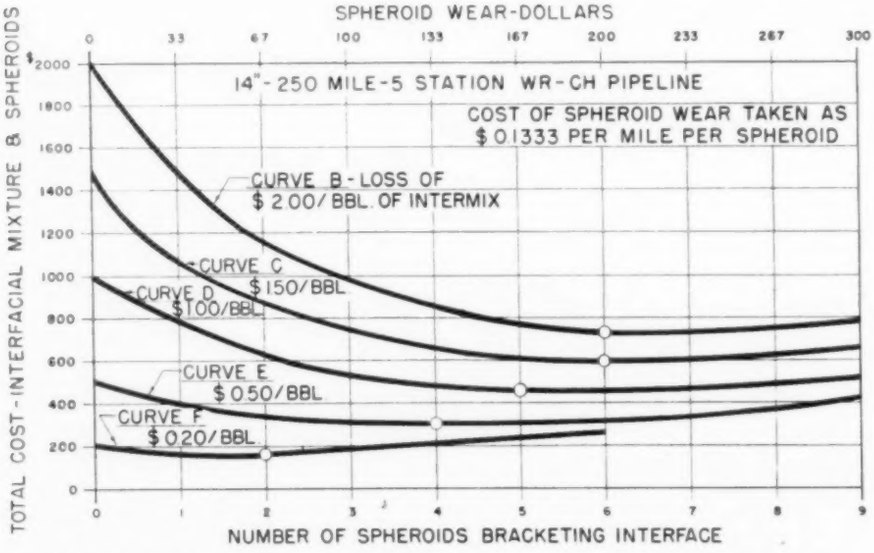


FIGURE 5—Optimum number of spheroids to produce minimum monetary loss.

Automatic Bypass of Spheres. It is normally necessary to take such spheroids past one or more booster pump stations. Such stations may employ automatic station bypasses for getting the spheroids through the stations without taking the pumps off the line yet keeping each spheroid in its exact relative position in the stream. Such bypasses built by Shell require a minimum of 23 seconds to get any one spheroid across the station. Therefore spheroids cannot properly traverse such a bypass if they approach a station less than 23 seconds apart. Figure 3 shows the minimum spheroid launching spacing in seconds for a minimum allowable spacing of 120 lineal feet apart and a 23-second time requirement for any automatic station bypass. Such a graph can be plotted to fit the conditions of any pipe line.

Intermix Volumes. The greater the number of spheroids used to bracket an interfacial volume the better the protection. But it is evident that there is a diminishing degree of protection per spheroid as the number is increased. Ultimately the point is reached where the further addition of spheroids gives no appreciable added protection because optimum minimum spacing has been reached and the interface completely bracketed.

For instance, with no spheroidal protection, about 1,000 barrels of mixture is generated; with 2 spheroids, the mixture will be about 550 barrels, with 5 spheroids, about 300 barrels, and with 9 about 250 barrels. Knowing the amount of mixture, the cost of degraded interfacial mixture and the cost of running spheroids as protective devices, we can plot a graph like that shown in Figure 5, which shows the most economical number of spheroids to use to protect any given interface.

Spheroid Spacing. The spacing of spheroids in an interfacial mixture may be summed up as follows:

The first spheroid must be inserted right at the head end of the originating interfacial mixture.

Subsequent spheres, up to the maximum economical number must be equally spaced throughout the interfacial mixture or permitted to extend into pure liquid following the interfacial mixture, provided their mini-

mum volumetric spacing is the greater of (1) the volume contained in 120 lineal feet of line or (2) the volume which will pass through any ancillary spheroid handling system (such as an automatic station bypass) in its minimum cycling time.

The maximum spacing between successive spheroids should be maintained as close as possible to the minimum spacings specified provided that the optimum economical number or spheroids must equally subdivide the original interfacial mixture and bracket it with the final spheroid in substantially pure liquid at the end of the interface.

Effectiveness of Spheroidal Product Separation. Although construction of all the automatic spheroid handling equipment intended for Shell's Wood River-Chicago line has not yet been completed, a number of test runs of spheroid protected interfaces have been made using manual control. These runs have proven the feasibility of spheroidal separation. Recalling that the interfacial mixture at Chicago with no mechanical separation is approximately 900-1000 barrels, we have separated batches of motor grade gasoline from range fuel with 2, 5 and 9 spheroid runs. The results are shown in Figure 4. Figure 6 shows the results of protecting an originating interface of 118 barrels at Wood River with 5 spheroids at 30-barrel intervals to Auburn (78 miles), then 7 spheroids to Sibley (155 miles) and 9 to Argo (250 miles).

Even though the manual spheroid handling caused some misplacement in this interface, the mixture at Argo near the end of the line was about 240 barrels.

It should be noted that we were trying to determine the best possible reduction of interface. The 75 percent reduction with 9 spheroids may not necessarily be the most economical procedure to follow for all interfaces. Perhaps 4 or 5 spheroids out of Wood River will be more realistic when completion of construction will permit more testing.

Mechanics of Launching Spheroids Into a Pipe Line. Any program of separation of fluids necessarily starts at the source of a pipe line where, in order to avoid stopping the pipe line flow, it is common practice to start flow of the trailing product before stopping the leading product. This

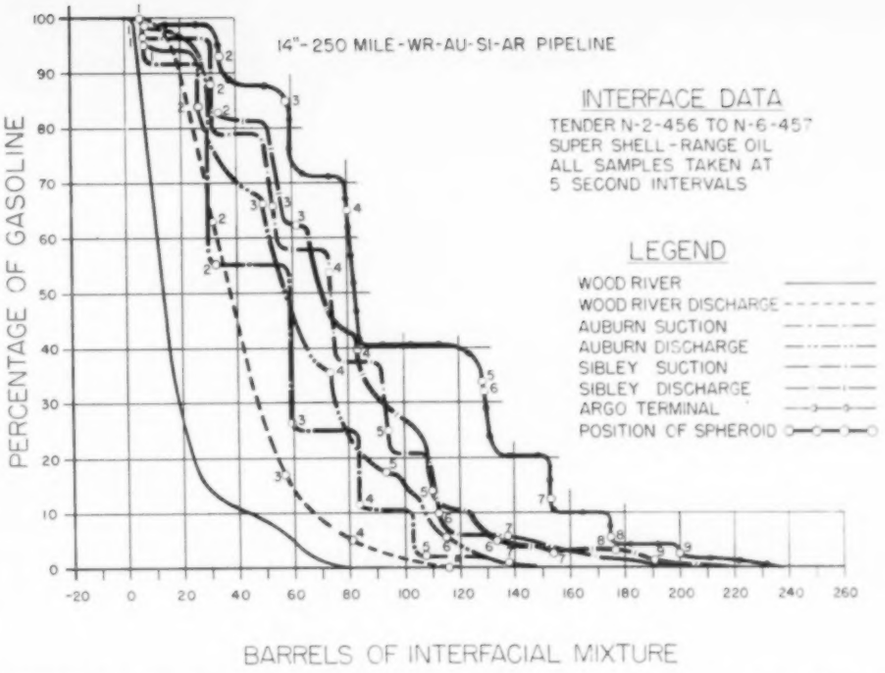


FIGURE 6—Results obtained with a 9-spheroid protected interface from Wood River to Argo, Ill.

means that at an originating station, there will be an interfacial mixture generated in the manifold valve area and through the pump. This volume of interface at Wood River pump station at the spheroid launching point has been determined to be between 70 and 90 barrels normally.

In keeping with the technique discussed above, we desire to launch the first spheroid immediately at the head end of the interface as it approaches the launcher and then subsequent spheroids, up to the most economical number required, at approximately equal intervals of not less than 120 lineal feet of pipe line with the last

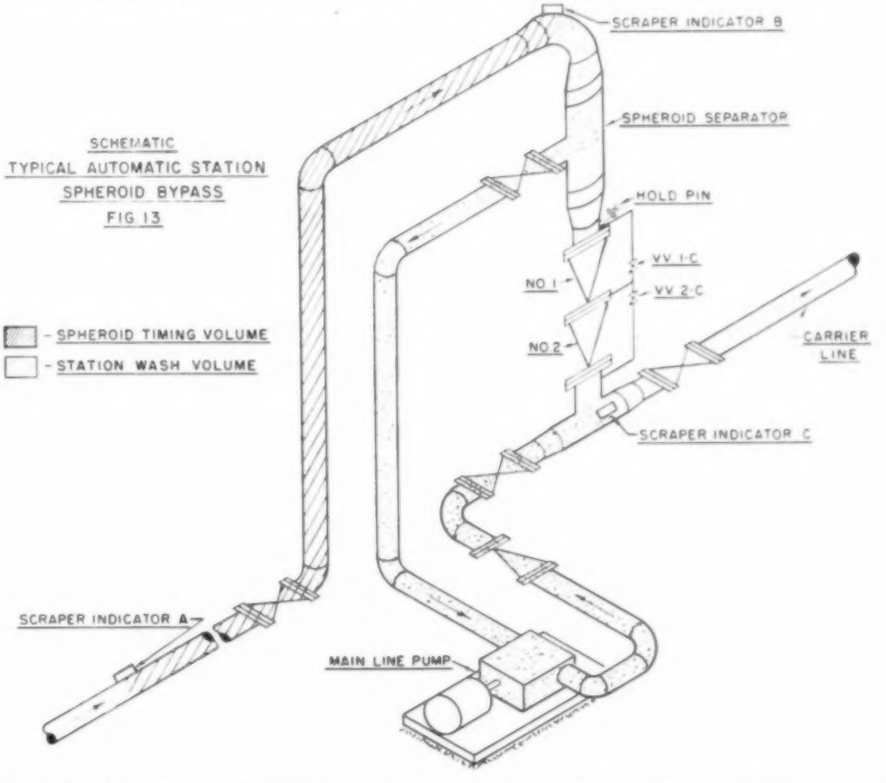


FIGURE 7—Schematic of automatic spheroid bypass at DeWitt station. The crosshatched volume is equivalent to dotted volume in time of flow. Indicators at A, B and C play the key roles in making the bypass.

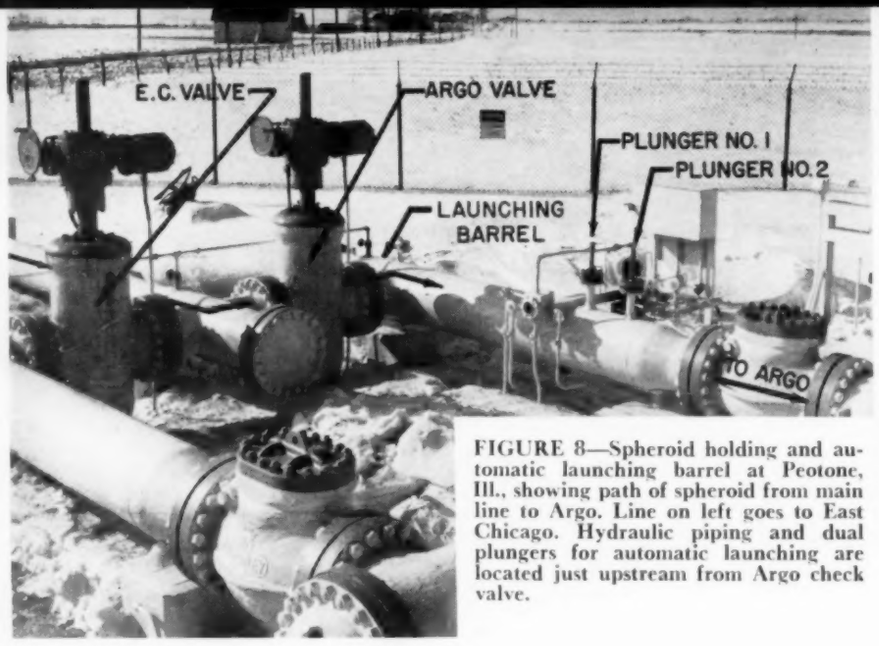


FIGURE 8—Spheroid holding and automatic launching barrel at Peotone, Ill., showing path of spheroid from main line to Argo. Line on left goes to East Chicago. Hydraulic piping and dual plungers for automatic launching are located just upstream from Argo check valve.

spheroid at the extreme tail end of the interfacial mixture or in pure trailing product.

Launcher Design. The launcher is basically a device for controlling spheroids as they gravity-feed into the pipe line. A schematic view is shown in Figure 1.

The launcher is loaded with spheroids with the check valve power-closed and the retaining pin withdrawn. When electrical signals command a spheroid to be launched (1) the retaining plunger is inserted, (2) the clapper opens to allow one spheroid to fall through, (3) the clapper closes and (4) the plunger is withdrawn. The spheroid falls into the oversize tee and is immediately washed into the carrier line.

Launching speed is one spheroid every 15 seconds. Here the launcher is isolated from the line for loading by existing block valves on the scraper barrel.

The two plungers on the bend of the barrel are spaced one spheroid apart: when electrical signals command a spheroid to be launched (1) the upper plunger is inserted, (2) the lower plunger is retracted to allow a spheroid to fall, (3) the lower plunger is inserted and (4) the upper plunger is retracted. These plungers are operated by small hydraulic pistons.

There is no doubt a number of ways to make spheroid launching automatic or semi-automatic.

Mechanics of Automatically Bypassing a Pumping Station. Shell plans to remotely operate the 5 intermediate pumping stations on its Wood River-East Chicago Line from a control center at Indianapolis. With unmanned stations, it is planned to pass the interface protecting spheroids through each station completely automatically by a scheme which does not disturb the normal liquid flow pattern at any station nor require stopping or throttling of the pumps.

Schematic layout of a typical automatic station bypass which is presently being developed is shown in Figure 7. The rather unconventional features of the piping are, of course, the height to which the spheroids are brought as they come into the station piping area, the spheroid separator and the arrangement of the two power operated check valves installed vertically and flange to flange between the overhead station suction pipe and the normal level station discharge pipe.

Bypassing a Station. (Figure 7). The volume of liquid (shown as cross hatched) contained in the line from scraper indicator "A" to indicator "B" is exactly equal the volume of liquid (shown as dotted) contained from scraper indicator "B" through the pump to indicator "C" at the oversized tee junction. This dotted volume is the station wash volume. By measuring the time it takes a spheroid to pass from "A" to "B," the pipe line flow rate for that spheroid is indexed to the control circuit so that when a spheroid strikes "B" that length of time is allowed to lapse before the spheroid is replaced in the discharge line at indicator "C." Through this means each spheroid is replaced in the station discharge stream at exactly the same point it was upon arrival at indicator "B." The pump continues to run at full speed during the spheroid transition and there is no flow through check valves 1 and 2.

Note that immediately down stream from indicator "B" the pipe, spheroid separator, check valves and bottom tee are one pipe size larger than the carrier line. The spheroid is brought into a vertical perforated sleeve surrounded by a still larger tee containing the pump suction line proper and it is at this junction that the spheroid leaves the flowing liquid and falls downward by gravity onto the flapper of check valve No. 1 while the liquid moves on toward the pump through the tee outlet.

With the first of a series of interfacial spheroids on top of No. 1 check valve, the hold pin is first hydraulically inserted, equalizing valve 1-C is opened to equalize the pressure across the top check valve No. 1 whereupon this top check valve is power-opened for two seconds and then is power-closed, allowing the spheroid to fall through. Valve 1-C closes, and equalizing valve 2-C immediately opens to equalize the pressure across the bottom check valve No. 2 and, upon signal from the timing controller, check valve No. 2 opens to drop the spheroid into the discharge stream at indicator C. The immediate closure of check valve No. 2 then closes valve 2-C, pulls the hold pin and places the bypass in position to handle a subsequent spheroid.

This sequence will be automatically repeated by any number of spheroids arriving at the pumping station. As pointed out earlier, the only qualification here is that the spheroids must be spaced in the interface at intervals of time which are not less than the cycling time for the bypass, otherwise the bypass will not replace them in the stream at the point where they were removed. This cycling time, in the case of Shell's 14-inch bypasses, is about 23 seconds.

Mechanics of Passing Spheroids to Laterals. In general, a spheroid will try to go with a fluid stream into side outlets. Even if there is no flow, a spheroid may tend to hesitate or even stop there completely if the rate of flow is low. Such characteristics of the spheroid were employed in the design of the junction to Argo and East Chicago shown in Figure 8. The 14-inch Argo and East Chicago block valves are remotely controlled; 14-inch spheroids protecting an interface come into the junction point and enter a 16-inch diameter pipe between the valves with

4-inch side outlets to the two valves. The spheroids are diverted at right angles at these 14-inch side outlets to either the right outlet (East Chicago) or the left outlet (Argo) depending on which valve is open to take the flow.

Facilities are still under development for a special operation in the Argo lateral at Peotone Junction. This leg normally takes only heart cuts of product from the line, and because of this, an interface is created in the Argo leg as the Argo valve is remotely opened. In order to minimize the spread of this interface, it is to be protected by spheroids automatically launched from the 20-inch diameter spheroid holding barrel.

This barrel is pre-loaded with the desired number of spheroids brought into it at the tail end of a delivery to the leg and stopped and held by the inserted Plunger No. 2. When a subsequent delivery is made, the spheroids are awaiting launching from the barrel. As the Argo valve begins to open, (1) Plunger No. 1 is inserted, (2) Plunger No. 2 is withdrawn, (3) Plunger No. 2 is inserted and, (4) Plunger No. 1 is withdrawn. This cycle takes about 5 seconds and launches the first spheroid. This first spheroid moves out 120 feet into the line where it strikes a scraper indicator whose signal launches the second spheroid. Similarly, the second spheroid, as it strikes the indicator, launches the third and so on until all of the spheroids have left the barrel. It is anticipated that three spheroids 120 lineal feet apart, with the first one at the head end of the interfacial mixture generated as the Argo valve opens, will provide sufficient protection for such movements to Argo.

Upon final arrival at either Argo, or East Chicago further north, the spheroids enter a sufficiently long 20-inch diameter receiving barrel which is bypassed to remove the spheroids from the pipe line.

Advantages of Spheroids. There are a number of mechanical and operational advantages of spheroids themselves and equipment which can be designed for their handling which implement the effectiveness of a fluid separation system:

1. Each spheroid is as effective a fluid separator as a single dumbbell type scraper used in the past.

2. Spheroids are more easily handled than scrapers; the force of gravity can be employed to roll or drop them in a fluid. This makes them highly conducive to automatic manipulation.

3. They can be handled (per unit) in smaller launching and receiving equipment than previous separators and, because the launching is positive, automatic and rapid once inaugurated, more separators can be precisely injected into a single interface than was formerly possible.

4. Spheroids have a wear life of 10 to 15 times that of disc or cup type scrapers, can run through a 250-mile 14-inch line without additional inflation and may be quickly re-sized when required, by adding water with a small pump.

5. Some types of elastomers tend to wear a circumferential flat on the spheroid exterior if inflated too large. However, such a flat does not affect the sealing ability of the worn spheroid when its minor axis is properly sized.

6. Spheroids have the ability to readily negotiate long radius, short radius and even mitered ells, to jump out of the side outlet of a tee, to be propelled (even upward) through oversized piping, and to negotiate satisfactorily a pipe at least one size smaller than the nominal spheroid size. They will form an absolute shut off if brought through a line into a suitable swedged reducer but if the pressure behind them is too great they will go on through. But a word of caution—they will stick in the bulbous types of check valves at low rates of flow.

7. Spheroids require a relatively small amount of fluid energy for movement. We have had as many as 20 of them moving in one line section at one time and were unable to determine any significant pressure changes on the station gauges.

Future Potential of Spheroids. Application promises of spheroids lie in the economies of pipe line operation for:

1. The proper use of multiple spheroids, particularly in large diameter lines, is an effective method of controlling and reducing the interfacial mixing, especially where such mixtures must be disposed of at destination at reduced prices over those obtained for pure fluids. Results indicate that the generation of mixture decreases as the number of spheroids employed in an interface increases. For instance, 5 spheroids between a gasoline-burning oil interface in our 14-inch, 250-mile line can reduce the interfacial mixture to approximately one-third of that obtained without mechanical protection. Additional spheroids have brought that figure down to around 25 percent.

2. The spheroid has proven satisfactory in displacing a fluid from a pipe line. One such instance involved the complete evacuation of warm glycerine from an 8-inch-1,600-foot barge unloading line in about 15 minutes with one pass of a spheroid pushed by air pressure.

3. The spheroid itself is more economical to operate than the dumbbell type scraper previously employed. The cost to run two dumbbells to protect an interface from Wood River to Chicago is approximately $165 whereas two spheroids can make the trip equally effectively for around $65 or less, a reduction in material costs of some 60 percent.

4. Operating labor costs at the extremities of the pipe line for this interface control program will not be materially reduced over our present system until automatic features are installed, but the labor costs for scraper handling at the intermediate booster stations will be reduced to zero by means of the automatic station bypasses.

5. Spheroid handling equipment can be built new for approximately the same construction cost as conventional scraper launching and receiving barrels and related piping for the spheroid facilities normally require fewer valves.

6. Spheroidal separation offers the possibility of economically handling smaller batches of petroleum liquids thus reducing capital expenditures for tankage and providing the ability to supply a market with smaller maximum inventories.

7. An as yet unexplored potential of the spheroid may lie in the fact that, since more of them can be launched in an interface, it may be possible to expand the number and type of fluids handled in a single pipe line. This necessarily might involve

Continued on Page 67

A SPECIAL

PIPE LINE FEATURE

Design Features of the Laurel Pipe Line System

Sixteen grades of products are distributed to 18 take-off metering points—thanks to outstanding instrumentation and controls

By James F. Stephenson and Marlan G. Jordan
Laurel Pipe Line Company
Camp Hill, Pa.

THE LAUREL PIPE LINE SYSTEM products line runs from the Philadelphia refining area to Cleveland (Figure 1). The pipe line proper starts at the Booth station and tank farm. Here 16 grades of product are delivered from refineries and stored in 9 gasoline tanks and 8 distillate tanks.

Products received at Booth are sized into separate batches or blocks in accordance with the demand created by the 15 sales terminals and two other carriers in the state of Pennsylvania, and four sales terminals and one other carrier in Ohio.

Products are pumped from a manned automatic station at Booth through 107 miles of 24-inch pipe line to a manned automatic booster station at Mechanicsburg, Penn. From here the product is pumped through 77 miles of 20-inch line to an unattended remotely controlled booster station at Duncansville, Penn. Products are further boosted by Duncansville station through 114 miles of 18-inch line into working tanks at a manned station at Aliquippa, Penn. Identity of shippers' products is maintained at the latter station, and products are rescheduled to supply four sales terminals located at Ellsworth, Atwater and Cleveland, and to another carrier at Ellsworth for transportation to destination. The 14-inch line between Aliquippa and Cleveland is 107 miles long.

Communications. The objectives of communications for the system are to provide reliable talking circuits and good quality circuits for telemetering and supervisory control of the pipe line. The company is joint owner of a microwave system between Philadelphia and Aliquippa, and has leased

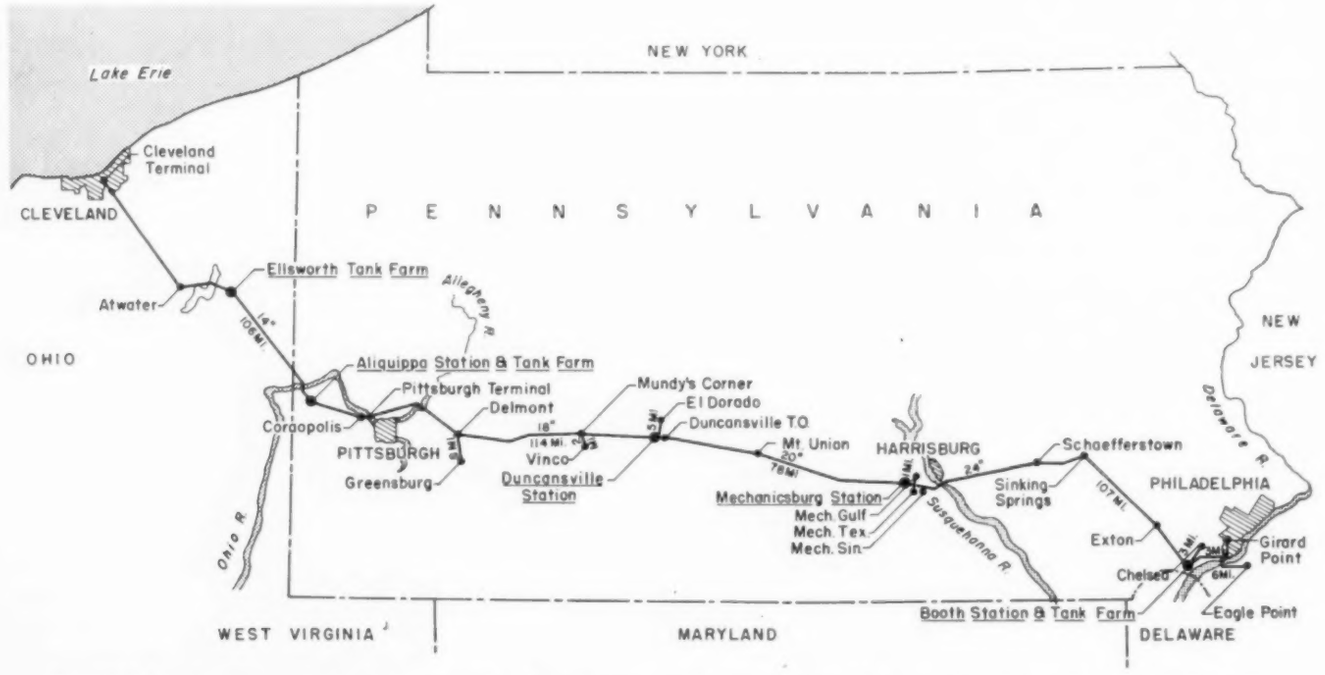


FIGURE 1—System map of the Laurel Pipe Line System, perhaps the most highly instrumentized in the United States.

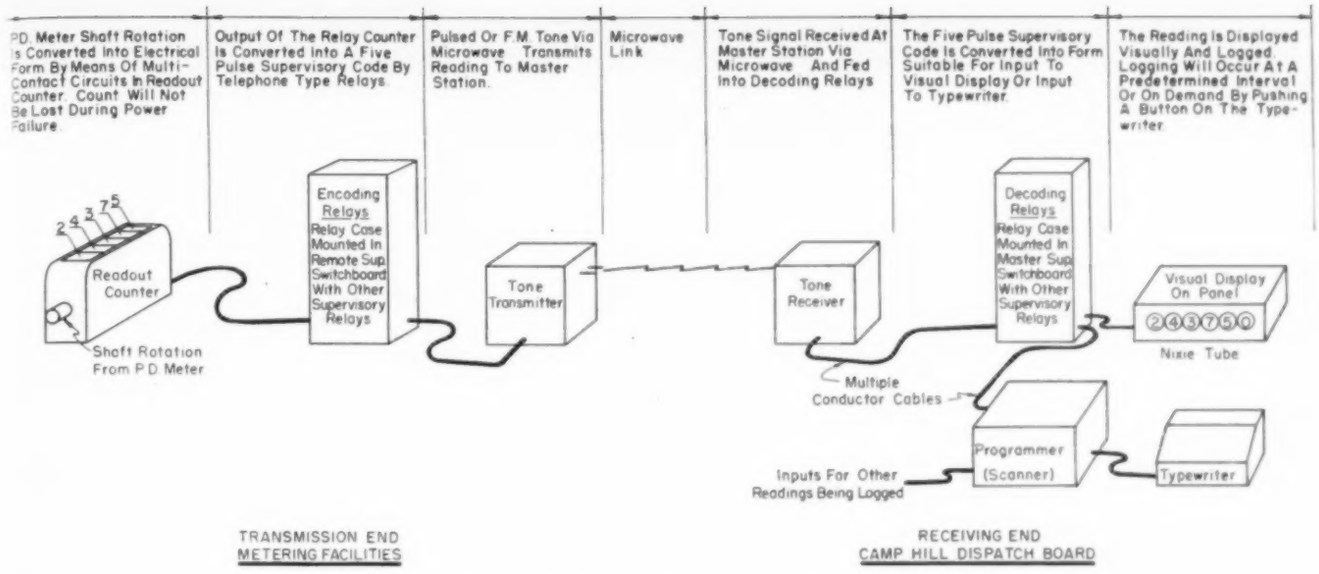

P.D. Meter Shaft Rotation Is Converted Into Electrical Form By Means Of Multi-Contact Circuits In Readout Counter. Count Will Not Be Lost During Power Failure.
Output Of The Relay Counter Is Converted Into A Five Pulse Supervisory Code By Telephone Type Relays.
Pulsed Or F.M. Tone Via Microwave Transmits Reading To Master Station.
Microwave Link
Tone Signal Received At Master Station Via Microwave And Fed Into Decoding Relays
The Five Pulse Supervisory Code Is Converted Into Form Suitable For Input To Visual Display Or Input To Typewriter.
The Reading Is Displayed Visually And Logged. Logging Will Occur At A Predetermined Interval Or On Demand By Pushing A Button On The Typewriter.
Readout Counter
Shaft Rotation From P.D. Meter
Encoding Relays
Relay Case Mounted In Remote Sup. Switchboard With Other Supervisory Relays
Tone Transmitter
Tone Receiver
Decoding Relays
Relay Case Mounted In Master Sup. Switchboard With Other Supervisory Relays
Visual Display On Panel
Nixie Tube
Multiple Conductor Cables
Programmer (Scanner)
Typewriter
Inputs For Other Readings Being Logged
TRANSMISSION END METERING FACILITIES
RECEIVING END CAMP HILL DISPATCH BOARD

FIGURE 2—Digital telemetering system for a positive displacement meter.

facilities between Aliquippa and Cleveland.

For maintenance and operation purposes a VHF mobile radio system is provided with base control stations at Camp Hill, Mechanicsburg, and Coraopolis, Penn. Through the use of the channel on the microwave system used for VHF mobile radio, personnel may be contacted anywhere on the pipe line system. Six channels east of Camp Hill, and ten channels west of Camp Hill are currently in service.

Central Operations. The dispatch board for the system and the central console for Duncansville remotely operated booster station are located in the Camp Hill office, near Harrisburg. This is the center of operations for the system. All intelligence indicated on the dispatch board is logged on an automatic typewriter at any predetermined time interval, or can be logged upon demand.

Intelligence received from the three refinery delivery points includes positive displacement meter readings and line pressure indicated continuously, and flow rates in barrels per hour are recorded continuously.

Intelligence received from the eighteen take-off metering stations includes continuous readings from positive displacement meter, and main line pressure gage. The product analyzer or batch detector and flow meter are recorded continuously. From the dispatch board the dispatcher has control and indication of take-off, and main line block valves and set point control of flow rates.

Dispatching. When notified that a meter station is in readiness to receive a delivery, the dispatcher can determine the location of the product to be delivered by means of a batch detector. If the delivery is to be a stripping delivery he opens the proper take-off valve. As it opens, he uses the indication of flow rate and pressure to set the control point to establish the selected delivery rate. The delivery rate can be changed from time to time to adjust to changing line hydraulic conditions.

Through the use of this set point control at the 18 metering stations, it is felt that the maximum line throughput efficiency can be attained at minimum power cost. From the positive displacement meter reading displayed by Nixie tubes on the board the dispatcher can determine when the predetermined delivery is completed. He can then close the take-off valve and the deliveryman can pick up the run ticket at his convenience.

The digital telemetering system for the positive displacement meters has a readout counter mechanically coupled to the meter totalizer (Figure 2). The totalizer rotation is converted into electrical form by means of multi-contact circuits and will not be lost during a power outage. The output of this readout counter is fed into encoding relays where it is converted into five pulse supervisory code. This pulse code is fed into the tone transmitter via microwave to the master station at the Camp Hill office. The pulse code from the tone receiver is fed into the decoding relays where it is converted in suitable form for input to the visual display and to the typewriter.

Time Duration Telemetering. The flow rates, pressures and batch detectors are telemetered by the analog or time duration method. These analog telemetering values are converted by an analog-to-digital converter disc located on the dispatch board and fed into the programer for use in the logging system.

From the Duncansville remotely controlled booster station comes station suction and case pressure, outbound line pressure, and flow rate, recorded continuously. Light type indication of: main and unit circuit breakers, power company voltage, unit incomplete sequence, position of station valves, low suction and high case pressure, high station discharge pressure, high outbound line pressure, high and low station flows and high strainer differential. These functions could be a transient condition and from the lights indication on the Duncansville console the dispatcher may determine if the trouble is a temporary condition. A channel test push

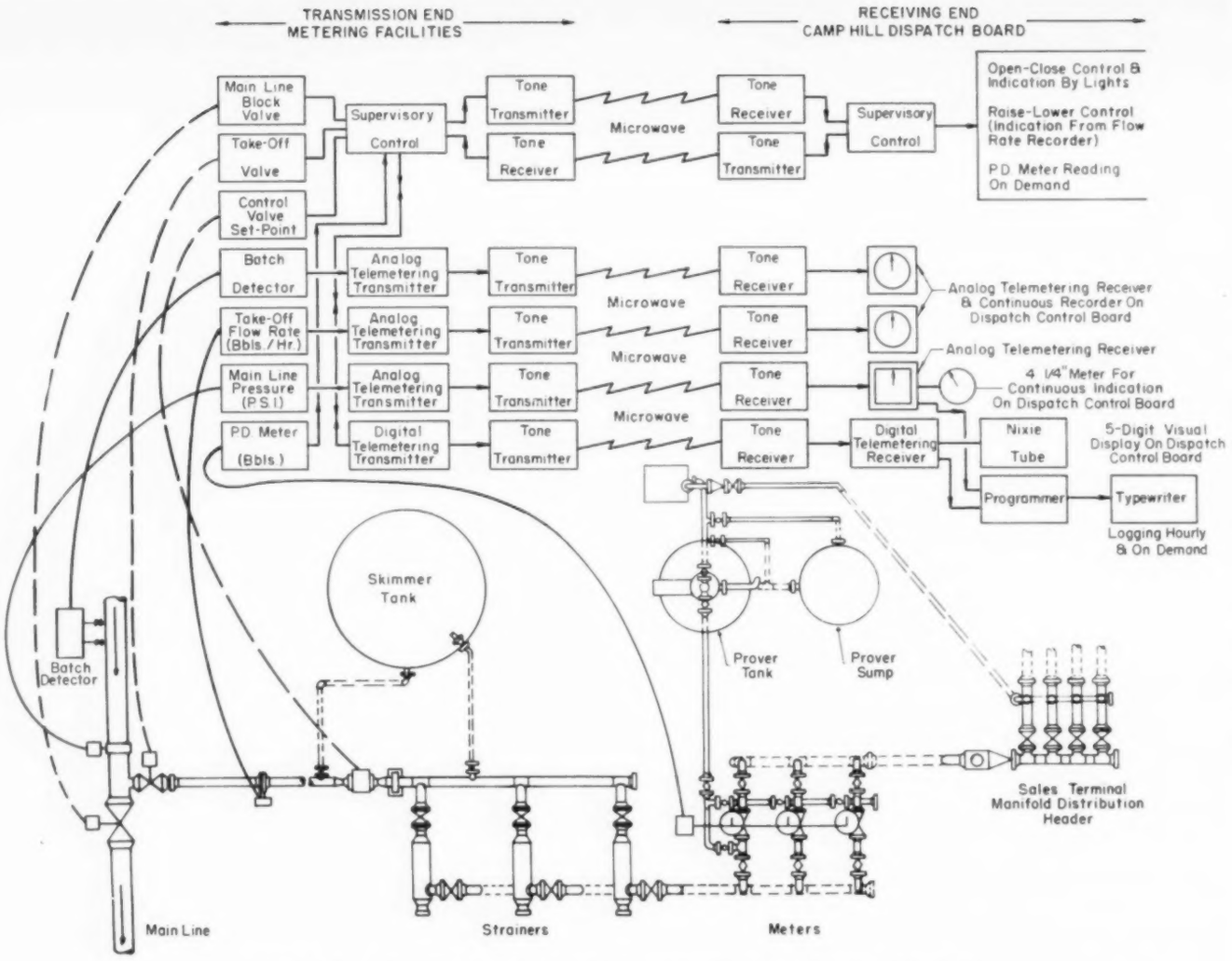


FIGURE 3—Telemetering and supervisory control functions at metering facilities.

button, channel failure light, ready and reset push button, and system check push-button are also provided for test purposes.

Shutdown. In the event of a station or unit shut-down the station console has lights indicating either mechanical or electrical trouble. A mechanical trouble light indicates that the shut-down was caused by excessive unit vibration, high pump or motor bearing temperature, pump seal failure, and pump case temperature. A mechanical trouble light without a shut-down would indicate high sump level or low instrument air. An electrical trouble light would entail single phase, station overcurrent, phase balance, high unit motor winding temperature, and unit motor overcurrent. An electrical trouble light without a shut-down would indicate low tripping battery voltage.

From the dispatching board and console the dispatcher has control of nine station valves, set point control of flow rate, suction and outbound pressure. An emergency shut-down push button is provided to completely de-energize the station.

Intelligence received from Booth station includes incoming flow rate on both refinery feeder lines recorded; station suction and outbound line pressures indicated continuously; outbound positive displacement meter readings indicated continuously, and outbound flow rate recorded.

Telemetered from Mechanicsburg station are station suction and outbound line pressures (indicated continuously) and the recorded flow rate. Intelligence from Aliquippa station received at the Camp Hill office includes incoming and outbound flow rates recorded on a circular chart; station suction; outbound line and two hill pressures are indicated by instruments. The positive displacement meter readings are displayed on the Nixie tubes.

At metering stations (Figure 3), the flow rate is controlled by an electrically driven hydraulic controller. The starting circuit of this control valve is governed by the limit switches in the take-off valve. When the take-off valve leaves the fully closed position the hydraulic pump motor starts and continues to run until the take-off valve returns to the fully closed position.

All meter totalizers are equipped with a set stop or preset switch which can be set for the amount of the delivery and when this predetermined quantity has been delivered the take off valve will close. On meter banks, where necessary, electrical counter shifters have been installed so that the deliveryman can shift the counters from the distribution manifold when a switch is made from one product to another.

A continuous sampler is installed at all metering stations so that a composite sample of the product deliv-

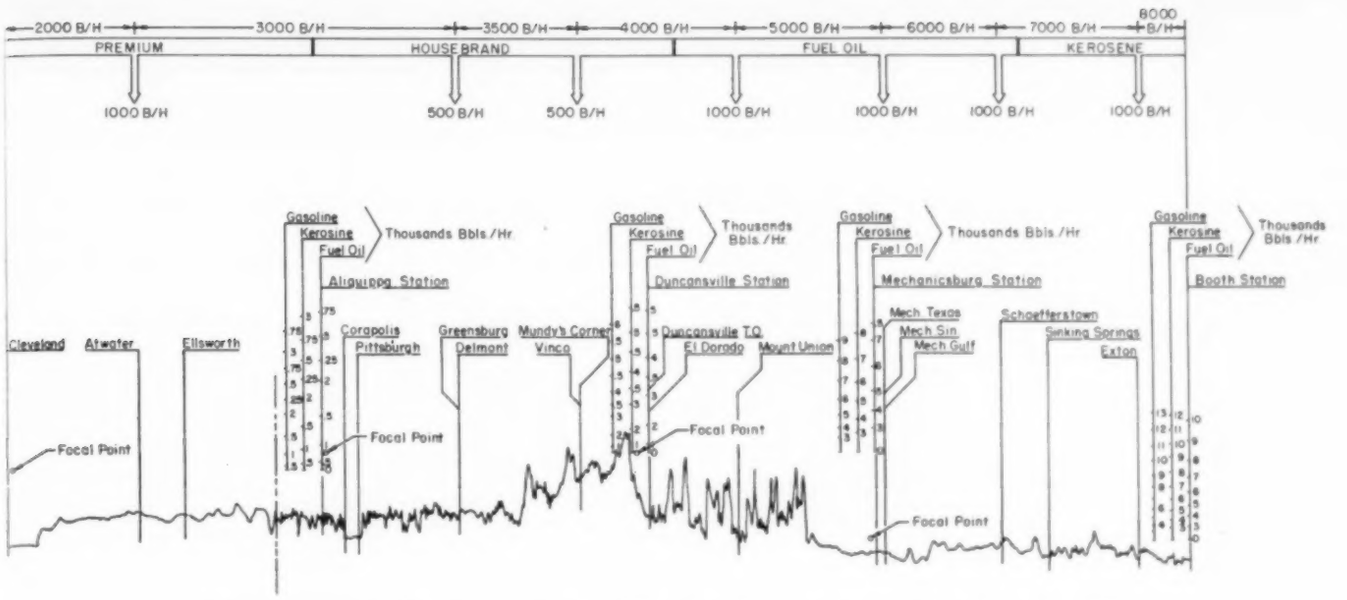


FIGURE 4—Hydraulic nomograph for dispatching control of the Laurel Pipe Line System.

ered is taken for future reference. The meters are manifolded so that they may be proved volumetrically or by the master meter method. Electrical counter shifters are installed to aid in the master meter proving method. Standby emergency generators at all locations automatically start when commercial power fails. These emergency generators furnish power for local and remote operation and for communications.

The main line pumping stations are automatic sequence operated with standard protection devices, including pump and motor bearing high temperature etc. All pressures indicated on the station control consoles are electrically transmitted signals from SR-4 strain gauges. The control rooms are of the pressurized type, housing indoor high voltage switchgear, motor control center, and other associated equipment. All tank farms are equipped with pulse code remote reading tank gauging equipment. Automatic standby generators at all stations furnish emergency power for operation of critical valving, lighting and power for communications equipment.

The booster pumps at Booth station can be started and stopped manually or automatically. When the booster pump control is in the automatic position and the station suction pressure falls below 25 psi, the starting sequence of booster pump No. 1 is energized. If the pressure output of booster pump No. 1 is not sufficient to meet the desired pressure, or if at any time while booster pump No. 1 is on the line, the pressure falls below this value, then the starting sequence of booster pump No. 2 is energized. When the station suction pressure exceeds 65 psi the booster pumps are shut down in a manner reversed to that described for starting.

Remotely controlled back pressure valves. Due to the hydraulic characteristics of the system west of Duncansville Station, a back pressure valve is located on the incoming line at Aliquippa station. It maintains a hydraulic gradient above Laurel or Crescent Mountain, the controlling high points between Duncansville and Aliquippa stations. To accomplish this a pressure tele-tax transmitted located near the summit of these mountains will control the back pressure at Aliquippa station to hold the hydraulic gradient above 25 psi at these control points. If full stream deliveries are made to either Pittsburgh or Coraopolis metering stations, the electro-hydraulic control valves at these metering facilities are controlled in the same manner as the back pressure valve at Aliquippa station.

From the foregoing description of the Laurel Pipe Line System it can be concluded that the automatic and central control features were incorporated in the system to reduce attendance cost to a minimum. We are indebted to the designers of the system, and to the equipment manufacturers whose experience and know-how contributed to the over-all design problem.

ACKNOWLEDGMENT

From a paper presented at the American Petroleum Institute, Pipe Line Conference, May 13-15, Pittsburgh, Penn.

About the Authors

Stephenson Jordan

James F. Stephenson is station construction superintendent of Laurel Pipe Line Co. After graduating from Texas A. & M. he was employed by Gulf Refining Co., first in summer work then after World War II as a corrosion engineer, electrical engineer and design engineer. He was assigned to the Laurel project in 1957. He was a major in the Army Corps of Engineers in World War II.

Marlan G. Jordan, chief engineer for Laurel, started work as a laborer with Gulf Refining Co. after graduating in civil engineering from Southern Methodist University in 1950. A year later he was advanced to civil engineer, and a year after that he became a design engineer in the company's Houston office. He advanced to his present position in 1958.

A SPECIAL

PIPE LINE FEATURE

Re-Examination of the Economics Of Sizing Crude Lines

Pipe line cost minimization based on cost of horsepower and the cost of the lines

By L. Cookenboo, Jr., and L. W. Smith
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THE PRINCIPAL FACTORS involved in cost minimization of pipe lines are the cost of the line itself and the cost of the horsepower—plus a prediction of things to come. Where a choice lies between capital goods which are bought now and used for many years and labor which is bought on a day-to-day basis over many years, it can be argued that the value of money spent now for capital goods should be considered in comparison with the *present* —not the future—value of labor which will be bought some years hence. The solution to such problems requires predictions of the economic life of the company, of future wage rates, of potential earnings from other projects to which the capital funds might be devoted, etc.

Prediction is a matter of judgment about the future and such judgments necessarily are uncertain. Hence cost minimization—if done rationally—involves the management in interest theory, wage theory and probability theory.

To keep the problem of cost minimization of crude oil lines within workable limits for discusssion, we shall assume away several potentially important variables: (1) unusual terrain variation; (2) looping; (3) safety factor; and (4) viscosity and gravity of crude. Any of these could be important variables requiring the exercise of economic choice; but we are seeking methods here, not detailed solutions. Hence we shall minimize costs assuming: (1) minimal terrain variation with uphills balancing downhills; (2) no loops; (3) a safety factor of 1.8 times pipe bursting pressure; and (4) 60 SUS, 34° gravity crude.

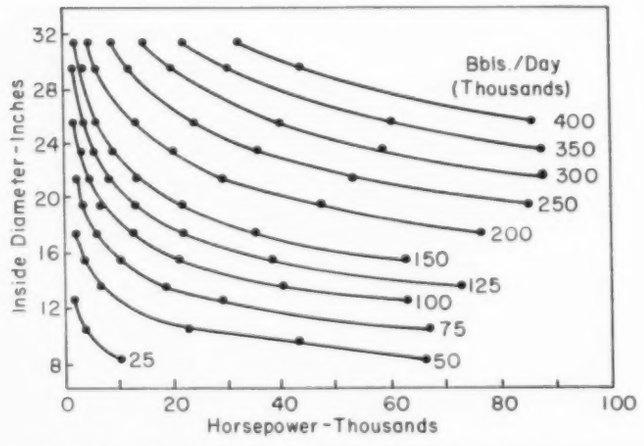

FIGURE 1—Iso-Product Curves, plotting line diameter vs. horsepower. Any combination of line size and horsepower coordination for any particular point on one of the curves will produce the daily throughput denoted by that curve.

Production Function. Given these assumptions, a set of technologically feasible alternatives is available to us as a matter of hydraulics. These alternatives are the substitution of diameter of pipe for horsepower:

$$T^{2.735} = (HP)\ (D^{4.735})\ (C),$$

where

T = Throughput,
D = Inside Diameter, and
C = Constant, reflecting gravity and viscosity.

This relationship is a production function composed of iso-product curves shown in Figure 1. Each curve shows the possible physical substitution of line diameter for horsepower for a given throughput.

Note that only one inside diameter is shown for each outside diameter of standard pipe. For example, 29.5-inch is shown for 30-inch. In all cases, this production function is drawn for ¼-inch wall thickness throughout (except river crossings). Of course, numerous other possibilities are available. However, ¼-inch throughout is usually the most economical piping program unless there are acute terrain problems. In this instance, the discussion will be greatly simplified by making such an assumption.

Line Diameter Costs. We must obtain prices for line diameter and for horsepower. In the case of pipe lines, these "prices" must represent conglomerate prices covering many individual materials. The price of line diameter is composed of the costs of all items which vary with size of pipe. These include initial costs of pipe, pipe freight, coating and other corrosion protection, construction service, line valves, etc. Total initial costs variant with line diameter are taken as follows:

Total Initial Costs Variant With Line Diameter
(1957 Prices)

Inside Diameter (Inches)	Cost Per Thousand Miles ($000)
8.125	$ 25,300
10.25	31,100
12.25	37,100
13.5	40,600
15.5	47,700
17.5	56,200
19.5	64,200
21.5	70,000
23.5	75,700
25.5	82,300
29.5	93,500
31.5	101,000

In addition to initial costs, another important item variant with line diameter is subsequent expenditures for property taxes. If we seek simply to minimize dollar outlays ignoring the time pattern of the expenditure, the property taxes would be the expected annual amount multiplied by the expected life of the line. However, we have seen the subsequent expenditures, such as property tax payments, should perhaps be discounted to present values in order to make these future dollar costs comparable with present dollars (where "present" is the time of construction).

Assuming a pipe line life of 25 years with negligible scrap values and assuming an annual property tax rate equal to one per cent of the initial outlay, the price per inch of line diameter in terms of present values is as follows—using a discount rate of 4 percent per annum:

Present Value of Initial Line Costs and Property Taxes

4 Percent Interest Rate (1957 Prices)

Inside Diameter (Inches)	Price Per Inch Per Thousand Miles ($000)
8.125	$3,607
10.25	3,508
12.25	3,504
13.5	3,475
15.5	3,558
17.5	3,712
19.5	3,807
21.5	3,766
23.5	3,724
25.5	3,730
29.5	3,666
31.5	3,708

Horsepower costs for a given total horsepower vary somewhat depending on the throughput to be carried. But for our purposes of discussing methodology, we shall use only one throughput as an example.

Assuming a 25-year life and an annual property tax rate of 1 percent of initial costs, costs per horsepower for 150,000 barrels per day are as follows—using a discount rate of 4 percent per annum:

Present Value of Initial and Subsequent Horsepower Costs

4 Percent Interest Rate (1957 Prices)

Inside Diameter (Inches)	Required Horsepower Per Thousand Miles	Present Value of Cost Per Horsepower Per Thousand Miles ($000)
15.5	62,019	$1.813
17.5	34,910	1.898
19.5	20,915	1.997
21.5	13,171	2.089
23.5	8,645	2.189
25.5	5,873	2.287
29.5	2,945	2.486
31.5	2,160	2.628

Horsepower Costs. Total line diameter costs depend in general on the diameter of the line. They increase as the diameter increases; and they are, so to speak, a function of the amount of line diameter. On the other hand, total horsepower costs are a function both of the amount of horsepower and of how that horsepower is applied. The reason for this is that a given total line horsepower can be developed by many stations operating at low discharge pressures or by a few stations operating at high discharge pressures. Hence before pricing horsepower, it is necessary to determine an optimum operating discharge pressure and an optimum number of stations (or optimum station spacing, as the question is sometimes put).

These are in reality one question. Because many station costs are fixed or semi-fixed, there are decreasing per-horsepower costs associated with the operation of high-horsepower stations. A 3-pump station developing 4,000 horsepower requires no more workers than one developing 1,000 horsepower. Land and building costs per horsepower are also generally lower for high-horsepower stations.

It follows that the horsepower required for a given line should be developed by the smallest possible number of stations in order to minimize costs. The smallest possible number of stations is determined by the maximum discharge pressure acceptable on the line in accord with the safety factor. Each station should have sufficient installed horsepower to develop the maximum pressure, and the optimum number of stations equals the total line horsepower divided by this horsepower per station. The maximum discharge pressure is the optimum operating discharge pressure for the line; and stations are spaced equally along the line (given level terrain), with the distance between them equal to the total mileage divided by the minimum number of stations.

Having determined on a priori grounds (see also section IV on optimum wall thickness) the most economic way of developing the horsepower required for a given throughput in a given size of line, we can price our horsepower variable in accord with the initial and subsequent operating costs of the minimum number of stations feasible in accord with the safety factor. The total horsepower costs for various lines carrying 150,000 barrels per day (as an example) are as follows—assuming a life of 25 years:

Total Initial and Subsequent Costs Variant With Horsepower

150,000 Barrels Per Day (1957 Prices)

Inside Diameter (Inches)	Required Horsepower Per Thousand Miles	Cost Per Thousand Miles ($000)
15.5	62,019	$169,300
17.5	34,910	99,500
19.5	20,915	62,400
21.5	13,171	41,000
23.5	8,645	28,100
25.5	5,873	19,900
29.5	2,945	10,800
31.5	2,160	8,300

Present values of total costs and costs per horsepower are shown in Figure 3. While the total cost may appear linear, it actually increases at a decreasing rate. Hence the cost per horsepower falls as horsepower rises. The range between maximum and minimum costs per horsepower is + 21 to — 17 percent of the average of $2.173 thousand per thousand miles. Therefore, as in quantity discounts, the average is not very useful as a measure of cost per horsepower.

Cost Per Horsepower Variation. However, the cost per horsepower can be rather accurately described by a logarithmic functional relationship fitted to the data (see Figure 3):

$$\text{Log } P_H = 0.77597 - 0.109536 \text{ Log H},$$

where

P_H = Price of Horsepower and
H = Amount of Horsepower.

The correlation coefficient of the fitted line is + .995. The price of horsepower reduces to

$$P_H = \text{Anti-log } (0.77597 - 0.109536 \text{ Log H}).$$

Optimum Combination. Having ascertained total costs and prices of our two variables, line diameter and horsepower, we can now determine the optimum combination for our illustrative throughput of 150,000 barrels per day.

Table 1, an example of the results of the arithmetic approach, compares actual dollar outlays for both variables for a 25-year life with present values discounted at 4 and 10 percent per year respectively. On the basis of actual dollar costs, the 25.5-inch line (26-inch O.D.) is the cheapest by a few dollars; but within the accuracy of the data, its cost is the same as that of the 23.5-inch line. After discounting future expenditures at 4 percent per year, we find that the 23.5-inch line (24-inch O.D.) is the cheapest. At 10 percent interest the 21.5-inch line becomes optimal.

What causes this change of optimum size? As higher values are placed on money, horsepower costs decrease in importance relative to line diameter costs because a greater part of the former (especially wages and power) is attributable to subsequent operating expenditures. Hence we spend less initially on pipe and more later on wages and power—investing the pipe savings in the meantime. In other words, the price of horsepower decreases relative to the price of line diameter if we attribute a higher value to our presently held capital. And when the relative price of one input falls, that input should be substituted for the other until it becomes uneconomic to make further substitutions.

A short-cut graphical solution can be developed. The total expenditure for any combination of line diameter and horsepower in our example is:

$$E = P_D \cdot D + P_H \cdot H,$$

where

E = Total Expenditure (thousand dollars),
P_D = Price of Line Diameter (thousand dollars per inch),
D = Inside Diameter (inches),
P_H = Price of Horsepower (thousand dollars per horsepower), and
H = Total Horsepower.

This equation may be written as:

$$D = \frac{E}{P_D} - \frac{P_H}{P_D}(H).$$

There will be a family of these lines for all possible expenditures. In our case the equation is:

$$D = \frac{E}{3{,}647} - \frac{\text{Anti-log } (0.77597 - 0.109536 \text{ Log H})}{3{,}647}(H).$$

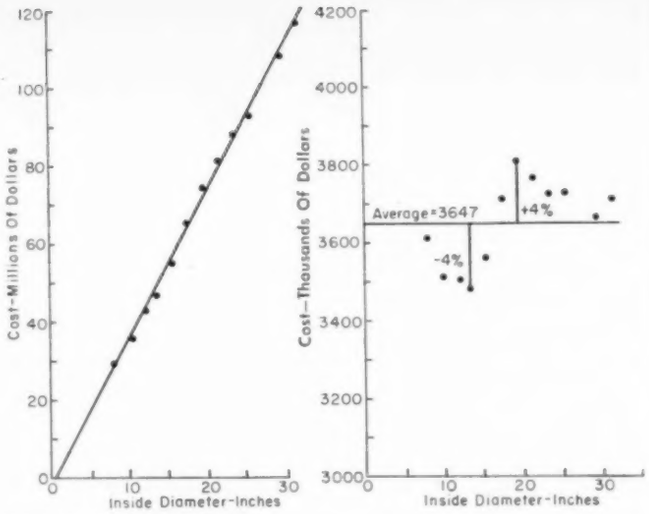

FIGURE 2—Total pipe line costs and costs per inch in present value dollars discounted at 4 percent per year. Note that a straight line fits the total cost relationship (the correlation coefficient is + 0.999). While the cost per inch rises and falls erratically, the maximum deviation from the average is about ± 4 percent. This gives a considerable accuracy of a constant price per inch of line diameter regardless of the diameter. This is $3,647,000 per inch of inside diameter per 1,000 miles.

A family of these lines covering discounted present values from $90-120 million is shown in Figure 4, together with the physical prossibilities for 150,000 barrels per day (from Figure 1). No expenditure measured by a line that lies to the left of the physical substitution curve can provide enough funds for a throughput of 150,000 barrels per day, since any combustion of line diameter and horsepower that satisfies such a line is too small to give this throughput. Note that the expenditures increase as the lines move out from the origin. Hence in order to minimize expenditures, we select the line which is closest to the origin *and* which touches or crosses the physical substitution curve. This is the line tangent to the curve. The tangency point confirms that the 23.5-inch line is optimal in combination with its required horsepower of 8,645. A more sophisticated explanation of the optimum point is

TABLE 1—Optimum Combination of Line Diameter and Horsepower, 150,000 Barrels Per Day—25 Year Life
(1957 Prices)

Line Size (I.D.)	NO DISCOUNTING			DISCOUNTED AT 4% PER YEAR			DISCOUNTED AT 10% PER YEAR		
	Line Diameter Costs	Horsepower Costs	Total	Line Diameter Costs	Horsepower Costs	Total	Line Diameter Costs	Horsepower Costs	Total
	THOUSAND DOLLARS								
13.5	50,712	309,919	360,631	46,908	204,804	251,712	44,252	129,262	173,514
15.5	59,628	169,318	228,946	55,154	112,438	167,592	52,032	72,741	124,773
17.5	70,231	99,477	169,708	64,962	66,269	131,231	61,284	43,093	104,377
19.5	80,261	62,424	142,685	74,239	41,763	116,002	70,037	27,343	97,380
21.5	87,537	40,985	128,552	80,970	27,512	108,482	76,386	18,109	**94,495***
23.5	94,601	28,083	122,684	87,509	18,926	**106,435***	82,555	12,534	95,089
25.5	102,820	19,858	**122,678***	95,106	13,434	108,540	89,722	8,950	98,672
29.5	116,928	10,756	127,684	108,156	7,320	115,476	102,033	4,922	106,955
31.5	126,265	8,295	134,560	116,792	5,676	122,468	110,180	3,847	114,027

NOTE: * Optimum
SOURCE: Computed from data in L. Cookenboo, Jr., "Costs of Operating Crude Oil Pipe Lines," **Rice Institute Pamphlet**, April, 1954, pp. 35ff, updated by the use of I.C.C., **Engineering News Record**, B.L.S., and cost indexes.

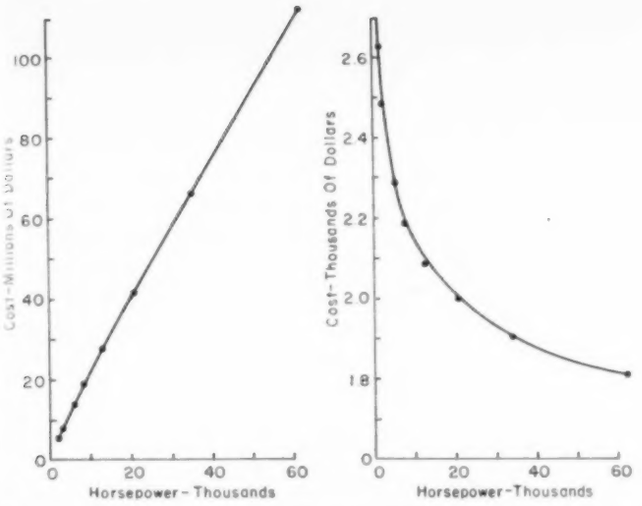

FIGURE 3—Present values of total costs and costs per horsepower. While the total cost (at left) may appear linear, it actually increases at a decreasing rate. Cost per horsepower falls as horsepower rises. Range between costs of horsepower is +21 to —17 percent of average of $2,173,000 per 1000 miles.

that it represents the point where the slope of the physical curve (the physical substitution ratio) is equal to the slope of the expenditure lines (the price or dollar substitution ratio)—or the point where

$$dD/dH = P_H/P_D.$$

When these ratios are not equal, it pays to substitute one variable for the other.

Practical Factors. One or two comments about this optimum are in order. First, we have assumed constant wage rates. Should inflation continue and should increased wages not be compensated by increased tariffs, horsepower would be underpriced. Hence larger line sizes might be deemed optimal if we were to attempt to predict future wages and shipping rates.

Second, the indicated combination for 150,000 barrels per day may not be optimal if we do not know with some certainty that the fields to be served by the line will produce that amount of oil. If we lay a 24-inch line and later find that its throughput is only 75,000 barrels per day, we will spend more for carrying the oil than we need have spent. Hence in choosing an optimum line size we must consider carefully the probabilities of carrying various throughputs in comparison with initial and expansion costs of various line sizes. These two problems are examples of situations where the mathematical solution must be tempered with judgment—or with a combination of judgment and more mathematics.

Optimum Wall Thickness. In the preceding section we considered the substitution of line diameter for horsepower. Similarly, we can consider the substitution of pipe wall thickness for a number of station locations. That is, we should like to find the most economical piping program and number of stations for a given throughput, line length, and outside diameter.

Two items must be determined before we can proceed. First, the maximum allowable discharge pressure for any given pipe wall thickness must be determined; that is, an appropriate safety factor must be chosen for the grade of pipe under consideration. Second, the minimum acceptable wall thickness must be selected on the basis of anticipated conditions during construction and when the pipe is in place. The available data indicate that there are considerable variations in practice on both factors. We have assumed a safety factor of 1.8 and a minimum acceptable wall thickness of ¼-inch, but the method of solving the problem will apply regardless of the figures chosen.

We have seen that there are two possible kinds of piping programs. All pipe may have the same wall thickness, or the pipe may be telescoped. That is, pipe walls will be thickest at the discharge side of a station; and as the pressure decreases along the line, thinner wall pipe is used as soon as the pressure drops enough. Since pipe costs increase with wall thickness, the only economical piping program with a single wall thickness is one using the minimum acceptable wall thickness. For if one used a pipe with a thicker than minimum wall, it would always be possible by telescoping to substitute thinner wall (cheaper) pipe for some distance up the line from each station and still remain within the maximum working pressure limitations.

How would we find the most economical telescoping program. We simply start back up the line from the suction side of any station. Knowing the required station suction pressure and the pressure drop per mile of the line, we would use the thinnest acceptable wall thickness for as many miles as possible until the maximum working pressure for that wall thickness was reached. Then the next thicker wall pipe would be used until its maximum working pressure was reached, and so on.

We should like to choose a piping program such that, for a given line diameter, the most economical combination of piping and station costs will be reached. To do this we shall assume that all station costs can be put into two categories for any given line diameter and throughput. One of these includes fixed and semi-fixed costs per station for site, building, valves, pumps, power to overcome station losses, labor, etc. The other includes costs for motors, power, etc., which are a function of horsepower. (Operating costs are included in this analysis by reducing all costs to an equivalent annual cost covering both investment and operation.) Now, for any given line diameter, length, and throughput, the total horsepower is approximately fixed. Therefore, the only costs which can influence our economic choice are the fixed and semi-fixed costs per station, i.e., those dependent on the number of stations.

Let us now consider that a pipe line is made up of equal segments—the lengths of line between stations. If the line is long enough, we can ignore the fact that the number of segments in the line may not come out even. Now, if we can find a segment—one station and its associated piping program—which has the least average cost per mile, we can make the most economical line by putting such segments together. This will give us a line with the least average cost per mile, since each segment will have the least average cost per mile.

Wall Thickness Cost Calculations. For any one segment we can write the equation for the average cost per mile:

$$\text{Average cost (\$ per mile)} = \frac{S + C_1 L_1 + C_2 L_2 + \ldots + C_n L_n}{L_1 + L_2 + \ldots + L_n},$$

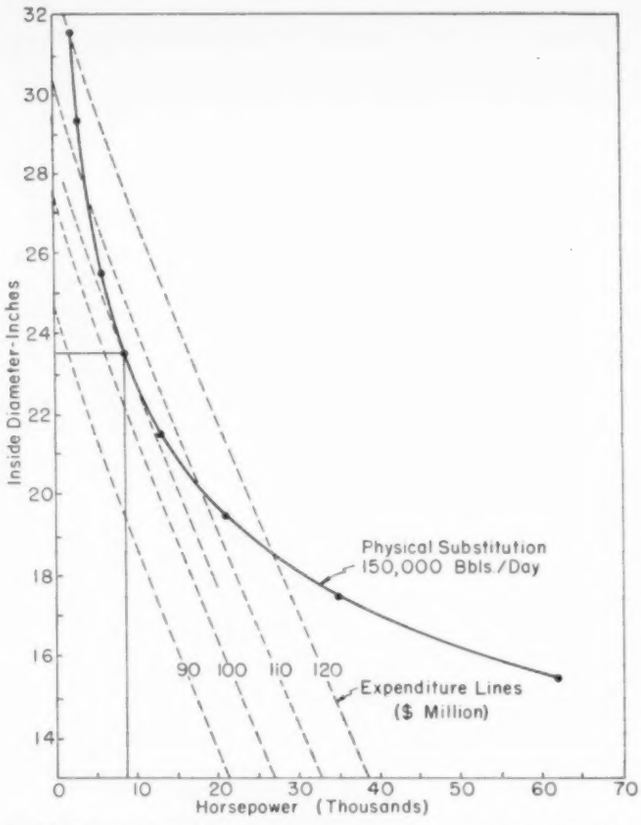

FIGURE 4—Graphical solution of optimum combination, 150,000 bbls. per day. The dashed lines are part of a family of lines for all possible expenditures. The lines at the left of the curve will not provide sufficient capacity, the lines at the right will provide too much. The point of tangency is the optimum.

where

S = Fixed cost of one station (dollars),
C_1 = Cost of line with minimum wall thickness pipe (dollars per mile),
L_1 = Length of line with minimum wall thickness pipe (miles),

and so on up to

C_n = Cost of line with maximum wall thickness pipe (dollars per mile),

and

L_n = Length of line with maximum wall thickness pipe (miles).

The length of pipe with any wall thickness is controlled by pressure limits, so we have:

$$L_i = \frac{\overline{P}_i - \overline{P}_{i-1}}{a_i}, \text{ for } i = 1, 2, \ldots, n,$$

where

L_i = Length (miles) of i^{th} wall thickness pipe,
$\overline{P}_i$ = Maximum working pressure (psi) for i^{th} wall thickness pipe,
$\overline{P}_o$ = Station suction pressure required,
a_i = Pressure drop (psi/mile) for i^{th} wall thickness pipe,

and

index i increases with wall thickness (for minimum acceptable wall thickness, $i = 1$).

This set of equations defines a minimization problem with side conditions. Fortunately, we do not have to derive a general solution for it.

The question we should really like to answer is, "As we start designing back up the line from any station with some (usually minimum) wall thickness pipe, and we reach a point where the working pressure limit prevents continuing with the same wall thickness, what do we do—go to a thicker wall pipe or put in a station?" The criterion is simple:

If L is greater than K_i, put in a station, and start a new segment;
If L is less than or equal to K_i, continue the segment with the next thicker wall pipe;

where (assuming that i wall thicknesses have been used)

$L = (L_1 + L_2 + \ldots + L_i)$, the total length of the segment so far

and

$$K_i = \frac{S}{C_{i+1} - C_1}$$, the fixed cost of a station divided by the *additional* cost of adding a mile of the *next* thicker wall pipe over that of adding a mile of minimum wall thickness pipe.

If one continues the segment, do so until the working pressure limit is again effective and apply the criterion again.

Example: (These data are consistent with those used in Table 1.)

Assume:

24" O.D. Grade B seamless X-42 pipe.
Safety factor = 1.8
34° API, 60 SUS crude oil.
Fixed station cost—annual basis, 4 per cent interest—(S) = $106,205.
Pipe cost (delivered)—annual basis, 4 per cent interest = $17,030 per ton.

First stage (i = 1): (¼" wall thickness, minimum acceptable)

Working pressure ($\overline{P}_1$) = 694 psi.
Station suction pressure ($\overline{P}_o$) = 20 psi.
Pressure drop (a_1) = 3.228 psi/mile.
Cost per mile ¼" wall pipe (C_1) = $2,851.
Cost per mile 9/32" wall pipe (C_2) = $3,190.

Substituting in the appropriate formulas:

$$L_1 = \frac{694 - 20}{3.228} = 209 \text{ miles},$$

$$K_1 = \frac{106,205}{3,190 - 2,851} = 313.$$

Since L (L = L_1) is less than K_1, continue with the next thicker wall pipe. Second stage (i = 2): (9/32" wall pipe)

Working pressure ($\overline{P}_2$) = 782 psi.
Pressure drop (a_2) = 3.262 psi/mile.
Cost per mile $^5/_{16}$" wall pipe (C_3) = $3,537.

Substituting again:

$$L_2 = \frac{782 - 694}{3.262} = 28 \text{ miles},$$

$$L = 209 + 28 = 237 \text{ miles},$$

$$K_2 = \frac{102,890}{4,042 - 3,242} = 129.$$

Since L is greater than K_2, the segment is complete—put in a station.

Although this calculation indicates that nearly 12 per cent of the pipe in the line should have 9/32-inch wall instead of ¼-inch wall, the net saving is only about $2(per mile over the entire segment. Practically, logistic problems and quantity discounts on pipe prices would

robably outweigh this trivial calculated saving; and herefore the piping programs selected would probably be hat of ¼-inch wall pipe throughout with stations every 209 miles.

The decision rule demonstrated above is derived by differentiating the expression for the average cost per mile of a segment and setting the first derivative equal to zero—the classical minimization procedure. This derivation is given in the appendix to this paper. What it tests is whether the mile is less than the increase in cost per mile from using thicker than minimum wall thickness pipe.

Conclusion. We have examined the principles of cost minimization and their application to crude oil pipe lines. We have found—given our assumptions on safety factor, terrain, etc.—that the optimum line size for our illustrative throughput of 150,000 barrels per day is 22 or 24 inches (outside diameter) for interest rates of 4 and 10 percent respectively. The most appropriate wall thickness is ¼-inch throughout, or perhaps minimum telescoping with a few miles of 9/32-inch pipe and the remainder of ¼-inch pipe. The wall thickness conclusion differs somewhat from those in other studies which have investigated this problem. The outside diameter conclusion is in accord with earlier studies:

Study	Optimum Outside Diameter (Inches)
Hill (1942)	22
Hughes (1949)	22
Cookenboo (1954)	22 to 24
McLean (1954)	22 to 24
Young (1958)	20 to 22

These outside diameters tend to be slightly larger than those in some postwar lines of approximately this capacity. However, most of the differences are not great; and they may be attributable to the use of higher interest rates.

APPENDIX

(Notation is the same as in the body of the paper)

Given an expression for average cost per mile of a piping program, $\overline{C}$,

$$\overline{C} = \frac{S + L_1C_1 + L_2C_2 + \ldots L_nC_n}{L_1 + L_2 + \ldots + L_n}, \tag{1}$$

subject to

(2)

$$0 \leqslant L_i \leqslant \frac{\overline{P}_i - \overline{P}_{i-1}}{a_i}, \text{ where } 0 < \overline{P}_{i-1} < \overline{P}_i \text{ for } i = 1, \ldots, n,$$

and

$$0 < C_1 < C_2 < \ldots < C_n, \tag{3}$$

we wish to minimize $\overline{C}$ as a function of L where

$$L = L_1 + L_2 + \ldots + L_i \quad i = 1, 2, \ldots, n. \tag{4}$$

Because of (2) and (3) we can reduce the problem from one of finding a general constrained minimum to one of examining a series of cases. If all $L_i = 0$, $\overline{C}$ goes to infinity. By (3), it is obvious that L_1 should be the first L_i to become positive. Similarly, for any given L greater than the upper bound given by (2) for L_1, we can see that L_1 should lie at its upper bound. For if it did not, we could construct a program with a lower C by taking L_1 to its upper bound and decreasing some other L_i values by an identical amount. Similarly, for any L greater than the sum of the upper bounds of L_1 and L_2, both should lie at their bounds, by a similar argument.

Now if we are at any stage, j, where we have

$$L_i = \frac{\overline{P}_i - \overline{P}_{i-1}}{a_i}, \text{ for } i = 1, 2, \ldots, j-1, \tag{5}$$

our problem reduces to one of (a) finding L_j and (b) deciding whether L_{j+1} should be greater than zero. Before we can consider these problems, we must transform equation (1). Let

$$C_i' = C_i - C_1, \text{ for } i = 1, 2, \ldots, n. \tag{6}$$

Obviously $C_1' = 0$. Then (1) becomes

$$\overline{C} = \frac{S + LC_1 + C_2'L_2 + C_3'L_3 + \ldots C_n'L_n}{L}, \tag{7}$$

where L is considered to include all non-zero L_i. Taking the derivative of (7) with respect to L and setting it equal to zero (the classical minimization procedure), we have

$$\frac{-S}{L^2} + LC_j' - \frac{(C_2'L_2 + \ldots + C_j'L_j)}{L^2} = 0, \tag{8}$$

where it is assumed that (5) holds and j is the largest index with a non-zero L_i. This simplifies to

$$\frac{-S}{L^2} + \frac{C_j'}{L} - \frac{C_2'L_2 + \ldots + C_j'L_j}{L^2} = 0. \tag{9}$$

Now when $j = 1$, the third term vanishes and for other small j it will be very small. Therefore, we can get an appropriate solution (exact when $j = 1$) by dropping this term. Thus, we get the approximate solution for L with minimum $\overline{C}$,

$$L = \frac{S}{C_j'} = K_j \tag{10}$$

which is the basis for the criterion stated in the paper. Note that the effect of the approximation in (10) is to make K_i a little too small, hence, when $L = K_i$ $(i > 1)$ we should continue with another stage. Usually the difference between adjacent K_i is so great that the approximation will have no effect. We can also reasonably increase L_j at any stage up to its maximum by (2) because of the bias of the approximation in (10), and since when this analysis is applied to a real pipe line, the number of segments would not come out even and an adjustment of some kind will have to be made, which would reduce average segment lengths.

ACKNOWLEDGMENT

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About the Author

Dr. Leslie Cookenboo, Jr. has been manager of Richfield Oil Corp.'s Economic Research department for the past year. He earned his Ph.D. degree at Massachusetts Institute of Technology. His undergraduate work was done at Rice Institute where he taught economics from 1950 to 1957. He has been a consultant for a number of petroleum companies and authored several papers on pipe line industry economics and statistical subjects.

A SPECIAL

PIPE LINE
FEATURE

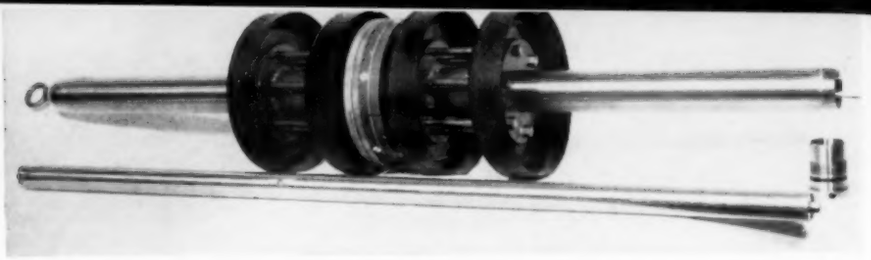


FIGURE 1—Pressure recorder for exploratory tests on pipe line pressure traverses. Pressure gage in foreground was adapted from deep oil well pressure gages.

What Goes on Inside a Pipe Line?

A pressure recording pig is pointing the way toward finding out. The pressure traverses shown here can be used to plot elevations or detect leaks

By Howard J. EnDean, Robert M. Howard and James E. Knizner
Gulf Research and Development Company, Pittsburgh

A TEST PROGRAM aimed at developing equipment and interpretation techniques for continuous pressure traverses of pipe lines has shown that such practices are entirely feasible, and such surveys could likely be expanded to include other operating and maintenance factors.

There are a variety of measuring procedures that are readily adaptable for continuous recording while instruments are pumped through a pipe line. A few of the measurable variables that could be recorded are:

1. Grade
2. Curvature
3. Roughness
4. Pressure
5. Temperature
6. Leakage
7. Possibly electrical potential

For this test, the possibility of modifying pipe line operating conditions for surveys was considered. It was concluded that to be generally acceptable, surveys should require no special conditions as to either delivery rate or equipment between terminals. It was agreed that minor modifications of terminal equipment would be feasible; i.e., scraper traps, piping bypasses, etc.

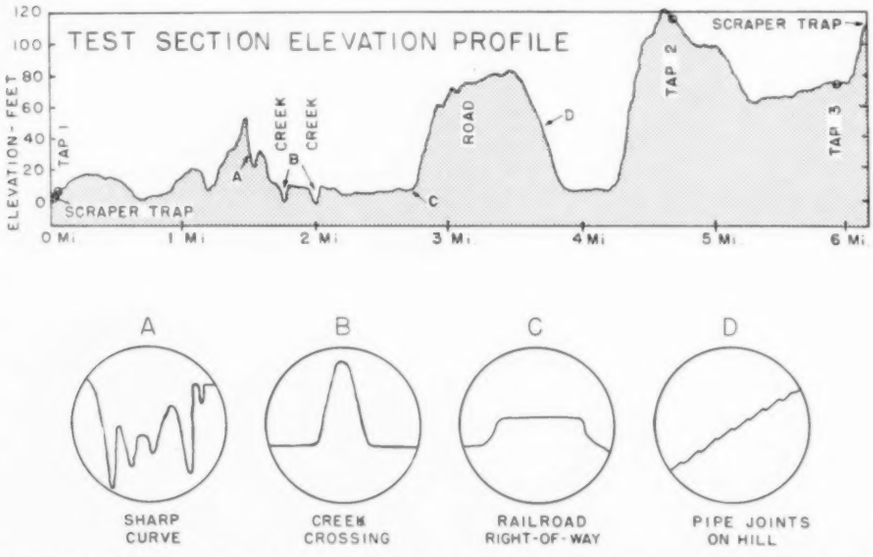


FIGURE 2—Upper half shows profile of 6-mile test section. Note the three taps used for leak simulation. Lower diagrams show pressure profiles of instrument.

The basic design criteria established were that a survey instrument should have dimensional and operating characteristics of pipe line scrapers. A further requirement was the equipment should be rugged and suitable for use by skilled personnel without special training in operation or record interpretation.

Exploratory Test Program. The preliminary study indicated a variety of surveys were theoretically possible. However, it was recognized that pumping instrumentation through a pipe line presented problems not encountered in normal instrument application. For this reason initial emphasis was directed toward determining the severity and variety of operating conditions that would be encountered.

Continuous recording of pressure traverses. While pressure variations were not considered of primary importance, background experience from bottom hole pressure surveys in oil wells indicated this recording could be made in pipe line operations. Another encouraging factor was the availability of rugged, accurate pressure gages adaptable to pipe line tests without major modification.

Exploratory tests were made in a crude oil pipe line operating on a routine basis. Limiting dimensions were the diameter of the 8-inch pipe line and the length suitable for navigating a 22½-degree long radius ell. Figure 1 shows the instrument used in the initial tests. In the foreground is a modified 1,000 psi bottom hole pressure gage inserted in the tubular body of the pig arrangement. Pressure ports were arranged so that pressure recording could be from the front of the assembly, between the center cups, or from behind the rear cup, depending on the purpose of the test.

A receiving trap was installed at

ne test section approximately 6 miles om the pump station to permit short st runs to study instrument behavior nd record interpretation procedures.

est Elevation Profile. The upper alf of Figure 2 is the profile of this -mile section. At the circled points n the profile, designated as taps 1, 2, nd 3, simulated leaks were created. These leak taps were opened during he period the pressure recorder was assing the taps to determine whether ignificant pressure anomalies could e detected. Also indicated along the profile are a number of typical line right-of-way obstructions that required a marked grade or direction change in the pipe.

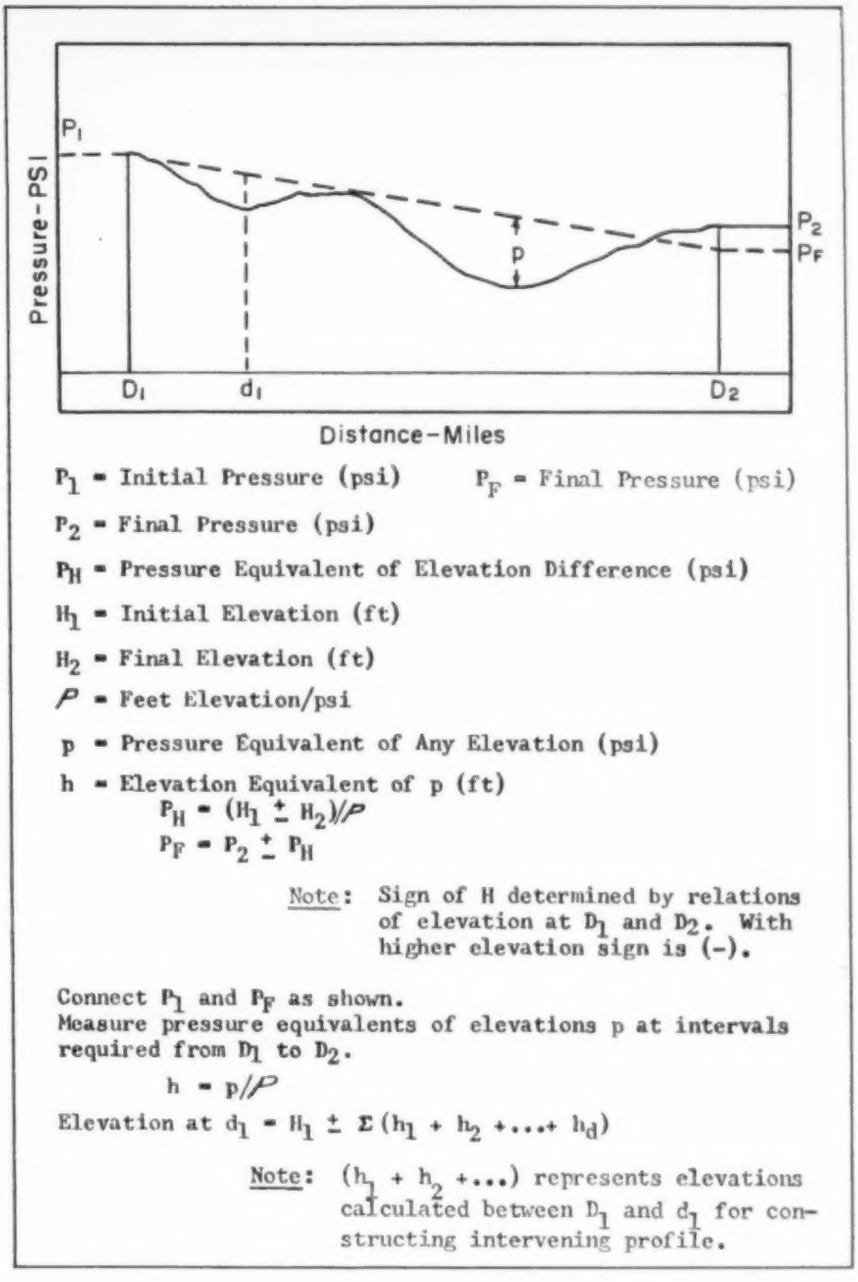
Bends, Creeks, Road Crossings Indicated. At each of the locations indicated, a pressure anomaly was observed. Typical examples of pressure recordings are illustrated in the inserts on the lower half of Figure 2. The form of recording would generally vary, depending on rate of travel, tightness of cups, and location of pressure inlet on the instrument.

Insert "A" illustrates a sharp curve. The pressure surges represent velocity changes of the instrument and accompanying pressure changes as cup friction varied.

Insert "B" is a typical creek or gully crossing type recording, the marked grade change causing a rapid pressure fluctuation as the instrument moved through the area. Insert "C" illustrates the type of recording frequently associated with railroad or road crossings. A marked pressure increase occurs as elevation is lowered, followed by a short interval of constant pressure, and a decrease of pressure as the line returns to normal grade.

Insert "D" shows a type of recording over the test section where a rapid change of grade occurred for a considerable distance. This line had bell-and spigot-type joints. Chill rings slightly reduced the inside diameter at each joint. With the instrument pressure inlet located between tight-fitting seal cups, pressure on the instrument was relatively constant between joints. When the instrument passed over a chill ring, the seal of the cups with the pipe wall was broken, re-establishing pressure in the instrument. This caused the pressure to increase or decrease stepwise as the pig ascended or descended an elevation change.

Interpretation of the data proved that with known constant delivery pressure and elevation at ends of the test section, the pressure record could be interpreted to give an elevation profile.



P_1 = Initial Pressure (psi) P_F = Final Pressure (psi)

P_2 = Final Pressure (psi)

P_H = Pressure Equivalent of Elevation Difference (psi)

H_1 = Initial Elevation (ft)

H_2 = Final Elevation (ft)

P = Feet Elevation/psi

p = Pressure Equivalent of Any Elevation (psi)

h = Elevation Equivalent of p (ft)

$$P_H = (H_1 \pm H_2)/P$$

$$P_F = P_2 \pm P_H$$

Note: Sign of H determined by relations of elevation at D_1 and D_2. With higher elevation sign is (-).

Connect P_1 and P_F as shown.
Measure pressure equivalents of elevations p at intervals required from D_1 to D_2.

$$h = p/P$$

Elevation at $d_1 = H_1 \pm \Sigma (h_1 + h_2 + \ldots + h_d)$

Note: $(h_1 + h_2 + \ldots)$ represents elevations calculated between D_1 and d_1 for constructing intervening profile.

FIGURE 3—How to determine elevation from charts.

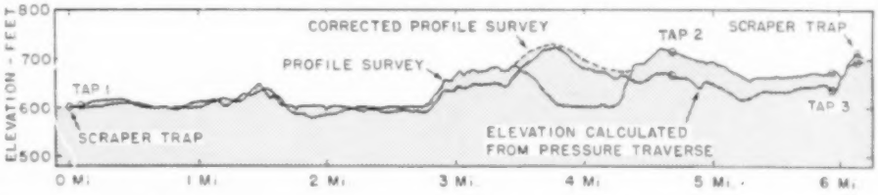


FIGURE 4—Comparison of measured and calculated elevation profiles.

"Reading" Pressure Traverses. The method of interpreting a pressure traverse in terms of pipe line elevation is shown in Figure 3. The idealized chart illustrates a pressure record of a traverse of a pipe line between locations D_1 and D_2. P_1 and P_2 and H_1 and H_2 are pressures and elevations at the beginning and end of the traverse. The difference in elevation at H_1 and H_2 is converted to pressure P_H. P_F is obtained by correcting P_2

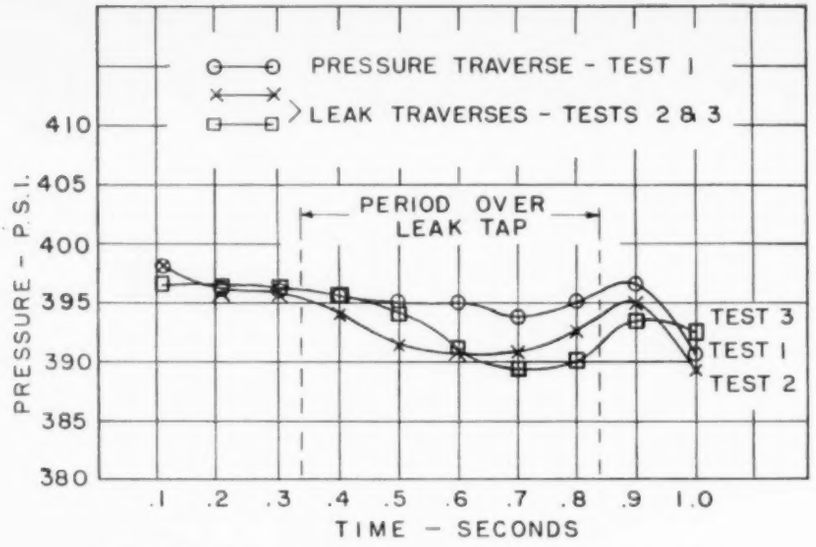


FIGURE 5—Pressure and leak traverse response at leak tap No. 3.

for difference in elevation by the addition or subtraction of P_H, depending on whether D_2 is at a lower or higher elevation than D_1. Pressures P_1 and P_F are then connected by a straight line as shown by the dashed line of Figure 3.

Uniform pressure drop illustrated by the dashed line represents the energy loss that would have occurred if there had been no change of elevation in the pipe line. The pressure equivalent of changes in elevation is the difference between dashed line and recorded pressure traverse illustrated as p on the figure. These pressure differences, when measured and converted to feet equivalents, are used to construct a line profile survey.

Elevation-Pressures Compared. Figure 4 compares the measured elevation profile with the conversion of pressures in the test section to an elevation profile. At milepost 4, it will be noted that the calculated elevation shows the line crossing a hill, while the surveyed profile shows the line in a valley. At the time of interpretation, this difference could not be explained; however, later it was found the elevation calculated represented the true line profile since the map had not been corrected for a relocation of the line. The resurvey of the line is indicated by the dotted portion of the profile.

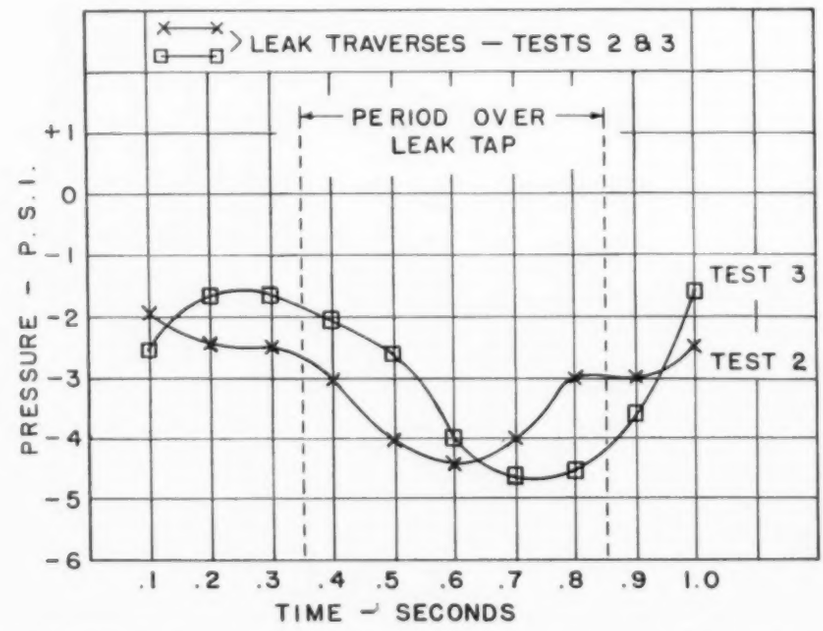


FIGURE 6—Pressure differential at leaks—pressure traverse—leak traverse, tap No. 3.

While the calculated elevations generally follow elevation changes of the land survey, there is a cumulative error caused by pressure variation. As illustrated later when constant pressures are maintained and necessary data recorded, a close approximation of elevation profile can be obtained from a pressure traverse.

Leak Location Tests. The leak tap locations on Figure 2 were used in the preliminary test program to determine if a sufficient pressure drop would be created by a leak (5 to 10 bph) to record on a pressure traverse survey. Pressure recording from in front or behind the drive cups of the instrument, produced no interpretable results. However, while the pressure recorder was bridging the leak tap, detectable pressure drops were created. This is attributable to a partial seal by the cups which seemingly persists until a sufficient differential pressure is created to deflect the cup and destroy the seal.

Anomalies in the order of 2 to 5 psi persisted during the period the leak was bridged. This varied from 0.25 to 0.50 seconds.

Pressures recorded during a standard pressure traverse and two leak traverses at leak tap No. 3 are shown on Figure 5. As shown in test 1 when the tap was closed, the pressure remained essentially constant during the period. However, in tests 2 and 3 a pressure drop of approximately 5 psi occurred during the period the instrument straddled the leak. Figure 6 illustrates the differential pressure between measured pressure traverse and the leak traverses during the time the drive cups were bridging the leak tap.

It was obvious leak anomalies would not exhibit a distinctive form that could be associated only with leaks. However, sufficient energy

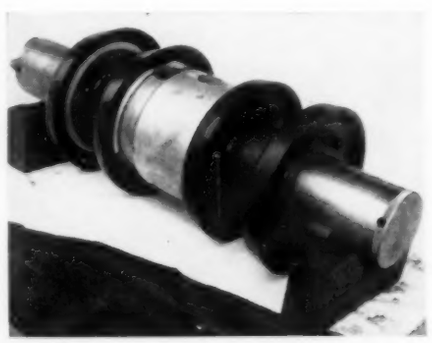
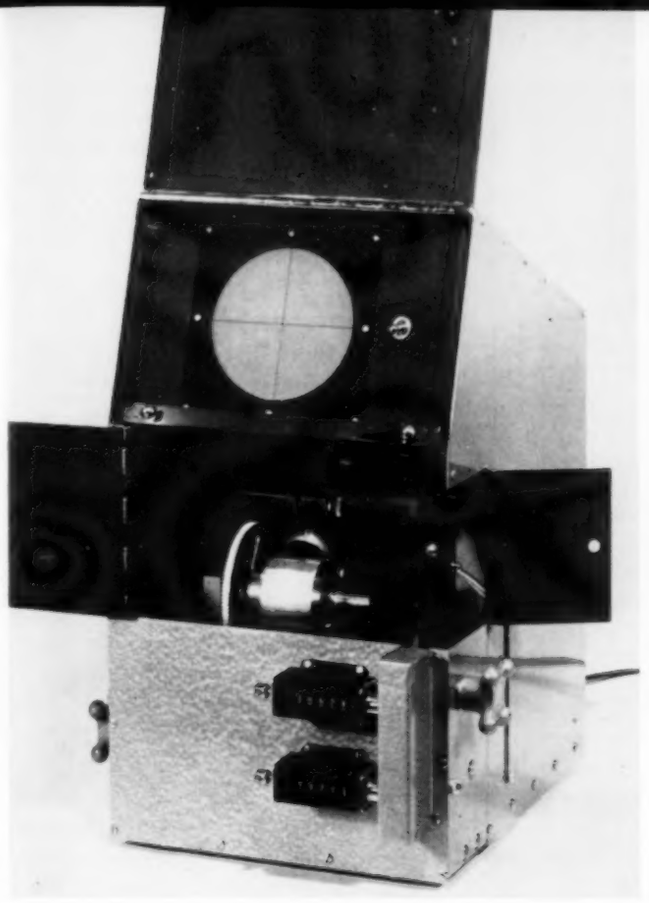


FIGURE 7—Pressure recording pipe line pig, which was run through both 6-mile and 60-mile section.



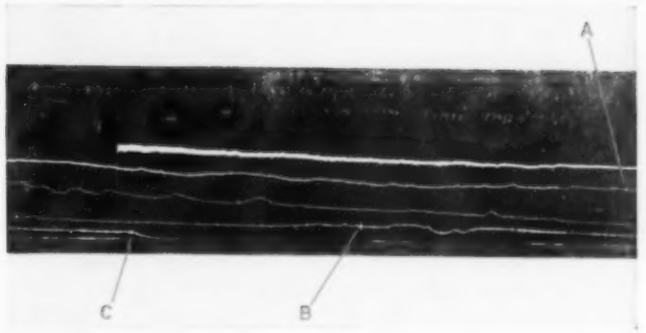


FIGURE 8—Routine pressure traverse survey for approximately 60-mile section.

Figure 9—Projection type chart viewer (left).

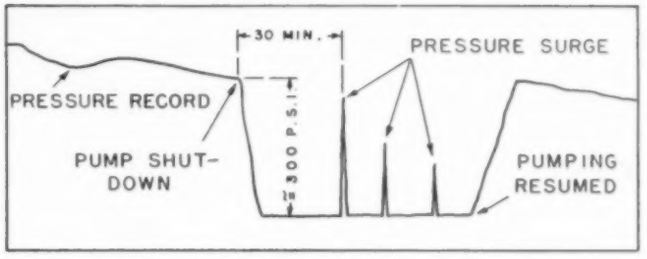


FIGURE 10—Pressure response during line shutdown at approximate mid-point of line section.

could be developed to operate instrumentation which might serve for leak detection.

Routine Pressure Surveys. Tests over the 6-mile section and others over 60- to 80-mile intervals between terminals proved the pressure element would be suitable for routine pressure surveys. The instrument shown in Figure 7 was developed for conducting routine pressure traverse surveys. As shown, the pressure element is mounted to 8-inch diameter cups. However, with minor modifications of cup mounting flanges, the element is applicable for pipe sizes up to 14 in. Above this diameter, certain major modifications will be required in pig body elements.

Clock-Driven Chart Units. All work to date has been with clock-driven chart rotating units. The reason: accurate, rugged, high torque clock motors have been available. Test experience to date indicates time can be used for determining instrument location with sufficient accuracy for most liquid pipe line applications.

Projection Chart Viewer. Figure 9 illustrates the instrument used for record interpretation. It is a projection-type system magnifying the record approximately 10 times. The two counter arrangements shown on the front of the instrument register time and pressure coordinates of the chart.

Practical Survey Factors. Using the standard instrument shown in Figure 7, a number of pressure surveys have been run in crude oil pipe lines. There is no reason to believe that the instrument would not be equally applicable to product and gas pipe lines.

A standard pressure traverse of approximately 60 miles is illustrated in Figure 8. The broad recording at the beginning of the test is due to surge action produced by reciprocating pumps. Where precise recording is necessary, these surges could be controlled by desurging equipment. In systems using centrifugal pumps, no significant surge action is observed.

The wavy response illustrates elevation changes of the line, with the sections concave upward being associated with valleys. The pressure "pip" indicated at point "A" on the chart is located at a line repair. Discussions with personnel indicated this was the approximate location where, in a leak emergency, the drift pin welding procedure had possibly been used. This was partially verified by a deep gouge along the instrument body at the end of the run. The anomaly indicated at "B" occurred at a check valve and the response at "C" is associated with a creek crossing.

In a subsequent test over this section, the line was routinely shut down. The procedure allowed approximately 30 minutes of drainage after stopping pumps at the delivery station before closing in the system.

When the pressure recording pig reached approximately the mid-point of the traverse, the line was shut down. Inspection of the chart record showed the pressure within the line dropped essentially to zero at the time the pumps were stopped. The pressure remained at zero until the valve was closed at the end of the drainage period.

Shortly after closing the valve, a large pressure surge was recorded by the instrument. This behavior is illustrated on Figure 10. The surge was slightly less than line pressure immediately prior to shutdown. It is possible if the valve had been closed immediately after pump shutdown and a surge of the same magnitude imposed on the operating pressure, maximum working pressure of the system would have been exceeded. As would be anticipated, a number of smaller surges were also noted as shown on the illustration.

In general, surveys in other pipe

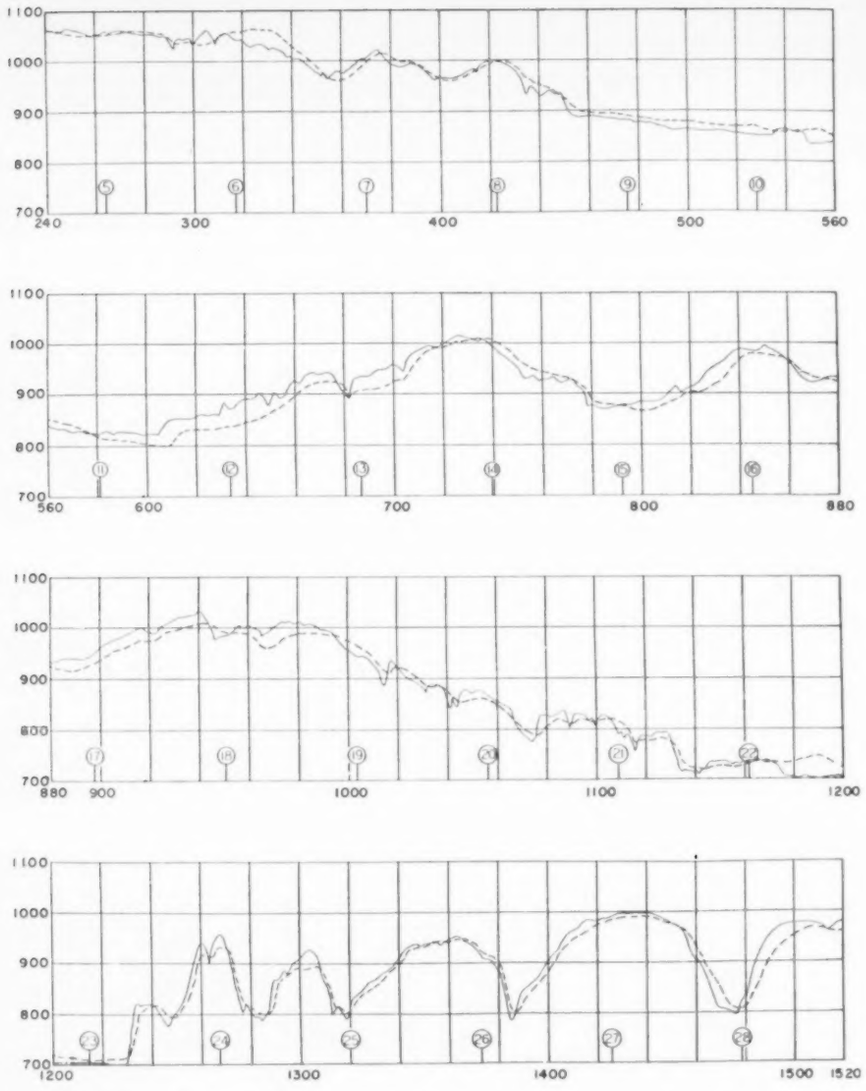


FIGURE 11—Comparison of surveyed and calculated elevation profiles for 12 miles of line. Solid line is from land survey; --- calculated from pressure measurement.

line sections exhibit the same type of anomalies noted in this survey. With the exception of the anomaly associated with the leakage repair noted above, pressure response in a traverse can usually be associated with items noted on the strip maps.

Comparison With Field Experience. In one of the tests conducted on the traverse shown in Figure 8, operating pressure was carefully controlled and data necessary for calculating elevations recorded. Figure 11 illustrates correlation between the standard survey and the profile calculated from the pressure record. This comparison covers approximately 25 miles of line. No attempt was made to detail small elevation changes. A careful study of pressure surveys where a line crosses rivers or rough terrain has indicated that an accurate elevation profile calculated from pressure would probably more closely approximate a pipe profile than a standard elevation survey.

In one test in a line where delivery was with reciprocating pumps, an unusual surge condition was observed that could be of significance. The type of surge action shown in Figure 8 at the beginning of the test run was present. However, even after initial surging had been dampened, periods of surge action occurred at locations farther down the line. In several instances magnitude of surges equaled those recorded at the beginning of the survey. It is possible these could be associated with pistons of the pumping units becoming periodically synchronized. Further investigations will be required to definitely establish the cause of this anomaly.

This phase of our research program is completed. The equipment developed for conducting pressure traverses is adequate both from the standpoint of ruggedness and accuracy. While a few pressure anomalies have been recorded that could not be associated with either operating conditions or pipe configuration, as experience is developed in interpretation, we can anticipate that cause of these anomalies will be determined.

Experiences in development and testing of pressure recording instruments indicate that conducting internal surveys in pipe lines is practicable. Moreover, methods and equipment for pressure, temperature and leak recording will probably be simple and rugged. The program has also indicated that no special operating procedures or training will be required in conducting or interpreting these surveys.

Further study indicates instrumentation for surveying such items as electrical potential, internal roughness, and corrosion pitting will require electronic-type circuitry. Such surveys may also require special operating conditions. Where the surveys require close interpretation of recording for pipe condition, the analyses of records will be time-consuming and expensive.

It is conceivable that equipment could be developed for automatic recording interpretation to expedite such investigations. Such equipment would be expensive and suggests that the most satisfactory arrangement for such studies would be by industry-wide service organizations. This would minimize the special survey instruments, interpretation equipment, and trained personnel required for the more complex type survey. With the contractual type procedure, it would be anticipated that the expensive instrumentation would have a rapid payout and reduce the costs of surveys to a reasonable figure.

Experimental work is being continued in a 500-foot, 8-inch test loop constructed at Gulf Research Center. In this loop it is possible to duplicate practically all operating conditions encountered in field operations. The present procedure in investigations is to reduce the development to a form suitable for routine operations in the

research loop, then confirm laboratory findings by field testing under routine operating conditions.

ACKNOWLEDGMENT

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From a paper presented at the Annual Pipe Line Conference of the API Division of Transportation Meeting, Pittsburgh, Penn. May 13-15, 1959.

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Coastal Transmission

Continued from Page 45

NGPL, Texas Illinois Natural Gas Pipeline Company and Natural Gas Storage Company of Illinois.

Superintendent of measurement for Houston Corporation and both subsidiaries, **W. F. Kienast** joined the firm in 1958 after eight years service with Montana-Dakota Utilities Company.

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At Humble he had been supervisor of electrical engineering. He is a member of the Central Committee for Radio Frequencies of the API and a director of the PIEA.

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Using Expandable Spheroids

Continued from Page 51

other considerations such as alternate freight charges, heavy line loads, quantities, etc. However, multiple spheroids present powerful pipe wall surface wiping ability with a wash time between each spheroid and we hope soon to do some work along this line.

8. Also unexplored is the possibility of further using the spheroid as a mechanical flag in the fluid stream. The correctly sized spheroid is positive in its ability to identify a point in a moving stream and this fact may prove useful as the sensing means in identifying interfaces, tender cutting, tank switching or other operations which could be more accurately performed if they were automatic.

9. Although the use of the spheroid in pipe line service is in its infancy and acknowledging that much more work must be done in the search for better elastomers, better hardware and better techniques, the work that Shell has done is culminating in an all-out batch separation program for its 14-inch North Line and gives us sound reason to believe that the spheroid can take its place as a useful tool for better fluid separation and fluid displacement than we have ever been able to obtain by previous methods.

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A SPECIAL

PIPE LINE FEATURE

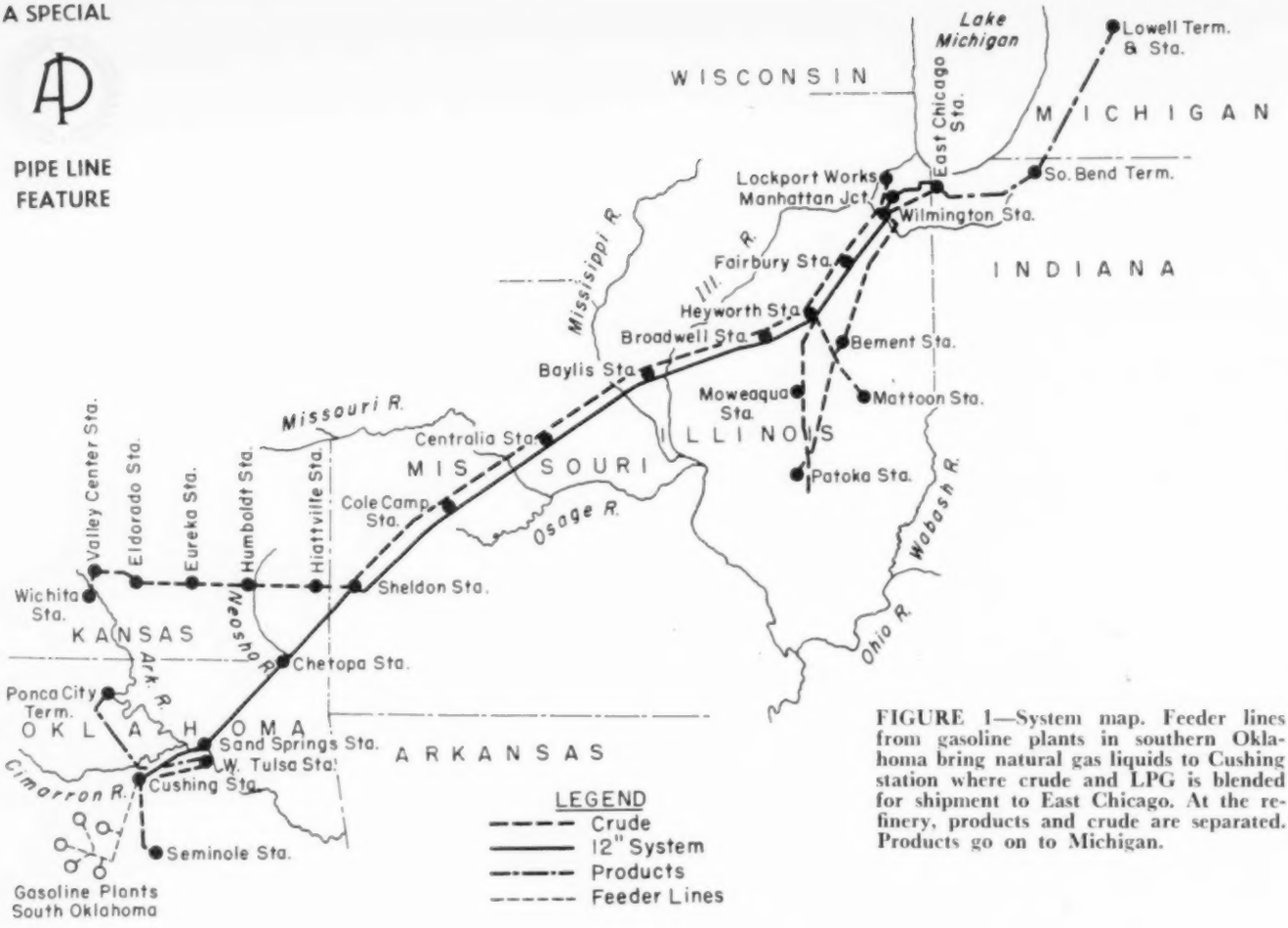

FIGURE 1—System map. Feeder lines from gasoline plants in southern Oklahoma bring natural gas liquids to Cushing station where crude and LPG is blended for shipment to East Chicago. At the refinery, products and crude are separated. Products go on to Michigan.

Mixing Crude With LPG, Distillates in Pipe Line

Handling such mixtures can be highly successful

By A. N. Horne, Vice President
Texaco-Cities Service
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MOVING VARYING mixtures of crude oil with natural gas liquids, middle distillates, and heavy end products through a 675-mile, 12-inch line modified for "tight line" operation is not only feasible, it opens rather broad possibilities for further ventures along these lines.

Such an operation has been carried out using a 12-inch crude line that runs from Cushing, Okla., to East Chicago. This line was laid in 1928, originating in the Seminole and Oklahoma City fields. The pipe was electric flash weld, bell and spigot joints, connected by bare rod arc welding. The nominal capacity was 70,000 barrels per day at 750 psi, with 2 electrically powered and 9 diesel stations, and appropriate working tankage at each diesel location.

Branch lines to Western Kansas and in Illinois, plus an increasing load on the system, prompted addition of 6 electric and one diesel booster station, followed by partial, and then complete looping during World War II. This resulted in two parallel lines from Sheldon, Missouri, to Wilmington, Illinois, with a capacity of 120,000 barrels per day.

Development. Beginning in 1938, this pipe line system has regularly moved batches of gasoline-crude mixture through conventional tankage and equipment. These batches which originated in Seminole, Okla., and Wichita, Kansas, areas have averaged around 10 percent of 26-pound natural gasoline with 90 percent crude of varying grades. The batches were usually floated through tankage at intermediate stations, with what has become recognized as normal or average interface mixture.

Markets for LPG have grown and this led to examination of the possibilities of pipe line transportation of propane and butane through existing crude oil lines, where regular products lines were not available, or could not be justified.

This system, as well as others, has in recent years made experimental batch movements of mixtures of crude and natural gas liquids with increasing volumes of the lighter products. These movements were successful through the conventional system when vapor pressures of the mixtures were held

below atmospheric pressure.

In 1956, plans for moving larger volumes of natural gas liquids from south Oklahoma to northern markets were completed. They were based on converting the 675-mile segment of the system from Cushing to East Chicago for "tight line" operation; the construction of a 165-mile 6-inch line from East Chicago to Lowell, Mich.; and, provision for the receipt from other carriers at Cushing of natural gas liquids from gasoline plants in south Oklahoma.

Conversion. The tight line conversion of the Cushing-East Chicago segment involved separation of the two interconnected parallel lines from Sheldon to Wilmington, and some load re-balancing.

Idle electric-centrifugal stations were revised for automatic (manual start), unattended operation (except for one man in daytime), and additional units were installed, with separate manifolding, for handling the mixed stream. Three of the original primary stations were kept in operation, one being entirely bypassed by the tight line, and the other two (Cushing and Sheldon, both with diesel driven reciprocating pumps) having manifolding and equipment separated from the crude system. Also, additional pumping units were installed at these two stations.

The revised system was placed in operation in December, 1957, using 2 diesel-reciprocating pump stations and 8 electric-centrifugal stations, with a nominal capacity of 57,000 barrels per day at 850 psi.

Tight-Line Operation. The operation is "tight line" and, as presently set up, is a coordinated, synchronized, continuous movement from origin to destination.

Beginning at gasoline plants in southern Oklahoma, varying mixtures of propane, butane, and natural gasoline move through the feeder lines to 7 metered injection points on the 6-inch connecting carrier line to Cushing. This mixed stream is metered directly into the suction manifold of reciprocating booster pumps, which discharge into the 12-inch main line going north.

Other reciprocating units at Cushing pump several grades of crude, and occasionally varying quantities of middle distillates and heavy end products, in volume sufficient to maintain a rate of flow for the current total requirements. Mixing occurs on the discharge side of the station. Occasional injections of crude mixed with natural gas liquids are made at Sheldon at the direction of the shipper.

The composite stream of the 12-inch line is metered to the refiner and fed continuously through a spheroid surge tank directly into the refining process.

Propane is received from refiners in the East Chicago area for delivery to shippers' terminals along the line and at the line's terminus at Lowell, Mich. The operation of the 6-inch line follows more or less normal routine of a conventional products system.

Flow Rate Increased. First movements through the complete system began at somewhat lower than normal capacity rate to permit necessary adjustments and synchronization of plant facilities.

The initial mixtures from the feeder lines to Cushing consisted of crude, 26-pound natural gasoline, propane, and butane, totaling an average of 9,400 barrels per day. The proportions of the mixture averaged 32 percent crude, 23 percent natural gasoline, 11 percent butane and 34 percent propane. The ratio varied considerably from hour to hour, and the vapor pressure ranged from 60 to 99 pounds, with viscosity in the range of 36 to 40 SSU.

At Cushing, sufficient crude was injected to bring the total volume up to 48,000 barrels per day. The resultant vapor pressure of the final mixture ranged from 30 to 50 pounds.

The crude component of the mixture from the feeder system was discontinued after a short period, and since that time the volume arriving at Cushing has been only the lighter products. This volume has ranged from 9,000 to 13,000 barrels per day, with vapor pressures ranging up to 113 pounds.

The crude injections at Cushing during an 8-month period consisted of varying quantities of 5 different grades, with API gravities ranging from 29.0 to 47.0.

During this period, the daily average pumpings out of Cushing ranged from 48,000 to 51,000 barrels per day. The composite mixture was thus proportioned approximately 20 to 30 percent light hydrocarbons and 70 to 80 percent crude with API gravity from 42 to 55 degrees, and vapor pressure from 24 to 50 pounds.

Fuel Oil, Residual Injection. Beginning in October, 1958, intermittent quantities of No. 1 fuel oil and residuum have been injected into the main line at Cushing along with the

TABLE 1—Typical Operations—16 Day Period—December, 1958-January, 1959
(In Barrels Per Day)

Components	*Kansas	Hewitt	Okla.	W.T. Sweet	Velma Sour	Total Crude	26 = Gaso.	Butane	Propane	Total NGL	= 1 Fuel & Residuum	Total Mix	R.V.P.	% Crude	% NGL	% Fuel
R.V.P.	3.5	4.5	9.3	10.6	3.8	—	—	—	—	65.8 89.6	—		—	—	—	—
Gravity	35.0	34.0	39.0	41.0- 47.0	29.0	—	—	—	—	—	37.1	51.9- 45.5	—	—	—	—
Dec. 23	1,545	15,189	16,808	—	—	33,542	5,225	2,847	1,794	9,866	3,172	46,580	31.1	72%	21%	7%
24	970	15,578	16,201	—	—	32,749	4,722	2,396	2,552	9,670	3,872	46,291	29.6	71%	21%	8%
25	2,210	15,633	16,613	—	—	34,456	4,640	2,436	2,740	9,816	3,347	47,619	33.3	72%	21%	7%
26	1,618	15,263	8,308	5,728	—	30,917	6,474	2,731	2,201	11,406	3,959	46,282	31.8	67%	25%	8%
27	1,316	15,036	—	14,192	—	30,544	5,058	2,324	2,820	10,202	4,426	45,172	38.6	68%	22%	10%
28	1,626	15,122	—	15,585	—	32,333	5,276	2,400	3,515	11,191	4,048	47,572	35.2	70%	23%	7%
29	39	11,047	—	20,835	—	31,921	4,989	2,111	3,320	10,420	4,108	46,449	35.2	67%	24%	9%
30	—	13,062	—	18,217	—	31,279	5,658	2,187	3,083	10,928	4,164	46,371	38.2	67%	24%	9%
31	—	12,005	—	20,744	—	32,749	4,405	2,053	3,039	9,497	4,165	46,411	38.2	71%	20%	9%
Jan. 1	—	11,912	—	16,896	4,485	33,293	5,047	1,933	3,509	10,489	4,166	47,948	38.2	70%	21%	9%
2	—	11,421	—	17,108	4,952	33,481	5,376	1,769	3,585	10,730	4,137	48,348	37.3	70%	21%	9%
3	—	10,210	—	18,512	4,865	33,587	5,725	1,251	3,554	10,530	4,369	48,486	36.7	70%	21%	9%
4	—	10,284	—	18,347	4,982	33,613	5,162	2,187	3,329	10,678	4,196	48,487	34.1	70%	21%	9%
5	—	10,522	—	18,291	4,808	33,621	6,576	1,445	2,939	10,960	4,224	48,805	33.4	70%	21%	9%
6	—	10,116	—	22,254	1,472	33,842	5,629	2,075	3,372	11,076	3,934	48,852	37.6	70%	21%	9%
7	—	11,952	—	22,381	—	34,333	5,876	1,232	3,489	10,597	3,801	48,731	35.7	71%	21%	8%

* Kansas crude injected at Sheldon contained 8% butane mixture under atmospheric pressure.

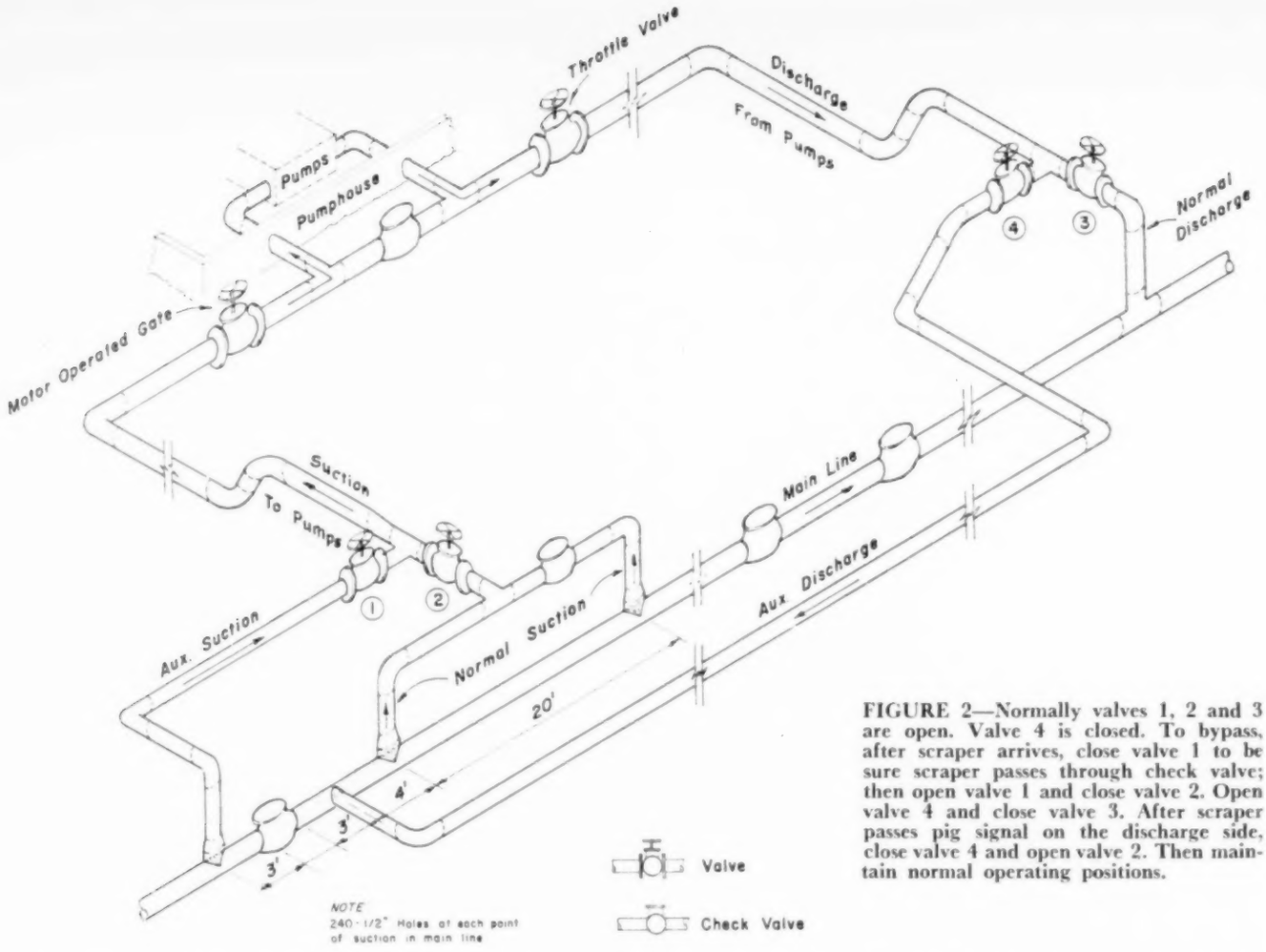

FIGURE 2—Normally valves 1, 2 and 3 are open. Valve 4 is closed. To bypass, after scraper arrives, close valve 1 to be sure scraper passes through check valve; then open valve 1 and close valve 2. Open valve 4 and close valve 3. After scraper passes pig signal on the discharge side, close valve 4 and open valve 2. Then maintain normal operating positions.

crudes. These middle distillates and heavy end products were received through a connecting carrier either as straight fuel oil or as a mixture of No. 1 fuel oil and residual stock, in the ratio of 30 percent residuum and 70 percent fuel, around 32° API gravity, and 60 SSU at 100° F. viscosity (Table 1).

The first shipment of No. 1 fuel and residuum arriving at Cushing through the connecting carrier products line was preceded and followed by straight fuel buffers to reduce or prevent contamination of other products, and all was further blended in tankage by the use of tank mixers before injecting into the main stream. However, there was some color contamination in the product following the residuum mix.

Movement of a possible 50/50 mixture of No. 1 fuel and residual stock to Cushing on a regular long time basis is under study.

Mixing and Control. As presently set up, there is no exact control over the methods or proportions of the mixture of the natural gas liquids arriving from the feeder lines through the connecting carrier to Cushing.

The quantity and proportions vary considerably and frequently, due to the fact that feeder line injecting stations at the plants operate on an irregular basis, being affected by local conditions such as truck and tank car loadings and other factors which affect stock situations at the gasoline plants.

During the first nine months of tight line operation, three of the several grades of crude as received at Cushing were mixed in tankage on a percentage basis in order to provide a more uniform stream for injection along with the lighter hydrocarbons. This procedure proved to be burdensome due to the number of tanks, tank changes, and gauge tickets involved, along with scheduling problems involving delivering carriers.

This problem was considerably alleviated by feeding the desired proportions of the different crudes from the respective tanks directly into the suction manifold of the injection pumps through throttling of tank gates.

Dispatching involves considerable detail with reference to scheduling. Volume fluctuations from the gasoline plants require frequent adjustjustments of the crude stream injected at Cushing to keep the main line throughout uniform. The connecting carrier advises of these variations as they occur.

Non-uniformity of the light hydrocarbon proportions received at Cushing, and the variable gravity and viscosity of the resultant mixture, cause large variations in pressures in the main line sections, and requires very close monitoring at the separation plant on the delivery end.

Volume may vary as much as 2,000 to 3,000 barrels per day. This could result in excessive power cost, except for measures which conserve energy.

Some 28 different pumping combinations have been worked out, which can quickly be implemented to control power costs.

Over-all scheduling information in the hands of the dispatching group and the refinery indicates the planned relative volumes of light hydrocarbons

TABLE 2—This apparent shrinkage took place over period of nine months

958	Bbls. Crude Recd.	Pump Out Factor	Pump Out Loss (Bbls.)	Bbls. NGL Recd.	NGL As % Of Total	Approx. Crude Qty.	Approx. NGL Qty.	Shrinkage Factor	Barrels Shrinkage	Total Calc. Loss	Actual (Shortage)	Shortage As % Of NGL
May	1,144,687	.0001T	114	235,565	17.1%	37.2	100.5	2.5%	5,889	6,003	(2,622)	(1.11)
June	1,090,568	.0001T	109	240,417	18.1	37.6	95.6	2.1	5,049	5,158	(2,842)	(1.18)
July	1,113,886	.0001T	111	275,935	19.9	37.9	104.3	2.7	7,450	7,561	(7,127)	(2.58)
Aug	1,147,319	.0001T	115	297,709	20.6	38.0	103.8	2.6	7,740	7,855	(2,864)	(3.54)
Sept	520,244	.0001T	52	146,039	21.9	37.0	110.8	3.2	4,673	4,725	(2,959)	(2.03)
Oct	969,035	.0001T	97	295,989	23.4	37.2	112.0	3.2	9,472	9,569	(4,485)	(1.52)
Nov	1,082,965	.0001T	108	289,100	21.1	37.2	107.1	2.9	8,384	8,492	(7,035)	(2.43)
Dec	1,108,033	.0001T	111	302,206	21.4	37.2	106.3	2.9	8,764	8,875	(3,403)	(1.13)
1959												
Jan	1,126,679	.0001T	113	350,466	23.7	37.2	106.7	2.8	9,813	9,926	(6,619)	(1.89)

Calculated Wt. Avg. Shrinkage 2.8%
Actual Average Shrinkage 1.9%

and crudes, but does not take care of daily or hourly variations.

In order that the refinery may exercise close control of processing, it is necessary to have as much advance information as possible covering characteristics of the composite mixture.

Transit time from Cushing to East Chicago is normally around 11 days. Consequently, the refinery is advised 7 days in advance of arrival of the general proportions, gravity, and vapor pressure of the daily delivery. In addition, gravity indication is continuously telemetered from the last upstream station, 54 miles or approximately 24 hours away. This continuous chart, with time lag calculations, enables the plant operators to more closely anticipate variation in proportions of mixture.

Scraper Schedules. Scrapers have been run on regular weekly schedules. The lengths of scraper sections, beginning at Cushing, are 187, 157, 277, and 54 miles. Scrapers are bypassed at 6 of the intermediate stations.

Paraffin Removal Climbs, Then Drops Off. At the beginning of tight line operation, larger than usual amounts of paraffin were removed at each of the 4 scraper traps. This condition prevailed for 4 to 6 months, when the quantities gradually decreased progressively from the initial station. At the end of 10 months, the deposits in scraper traps and strainers were very small, and by February, 1959, practically no measurable quantities were in evidence.

This indicates that the light hydrocarbons had a rather slow solvent action on the higher melting point, slightly adhering waxes, in a line that had been in crude service some 30 years. This same cycle occurred on the 120-mile 6-inch connecting carrier, which also had many previous years of crude service.

Bypassing Scrapers. In the earlier stages of tight line operation, bypassing of scrapers at intermediate stations resulted in much inconvenience and confusion. Procedure required that an operator be present to shut the station down, then get back on line after passage. This required pressure adjustments at other stations, and resulted in pressure surges, extra labor costs, and loss of throughput.

To correct this situation, a relatively simple arrangement was devised which permitted scraper passage without shutting down, and with no pressure surges, or adjustments at other stations, or loss of throughput. This was accomplished through minor changes and additions in the existing manifolds, whereby the scraper comes to rest after passing the station suction line. It can then be sent on its way at any time an operator is on duty by simple manifold valve manipulation. (See Figure 2.)

Losses and Shrinkage. The light hydrocarbon components of this system go "tight line" all the way from metered receiving point to metered delivery point, thus are not subjected to usual working tank vapor losses.

The crude component injected at Cushing is made up of West Texas Sweet, Scurry, Hewitt, Golden Trend, Oklahoma Sour, and occasional fuel and residuum. Kansas crude and gasoline/crude injections are made intermittently at Sheldon.

The crude components are injected from tanks on the down gage only, and the entire composite stream is metered at delivery point.

Over a nine-month period the calculated average shrinkage loss was considerably less than the values indicated on curves developed from laboratory experimental investigation. (Table 2.)

This difference could well be attributed to extrapolation for light hydrocarbon percentages higher than shown in the experimental curves, and to the complexity of the composite mixture in the pipe line. Also, to the fact that these rough calculations were based on the approximate gravity of the light hydrocarbon mixture and the approximate gravity of the crude mixture.

Conclusion. Existing conventional crude oil pipe lines can handle a wide variety of the direct and indirect products of oil and gas wells. With modifications, lighter and more volatile hydrocarbons can be added to the list. For future construction, proper basic design could provide for these broader possibilities.

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From a paper presented at the Annual Pipe Line Conference of the API Division of Transportation, Pittsburgh, Penn., May 13-15, 1959.

About the Author

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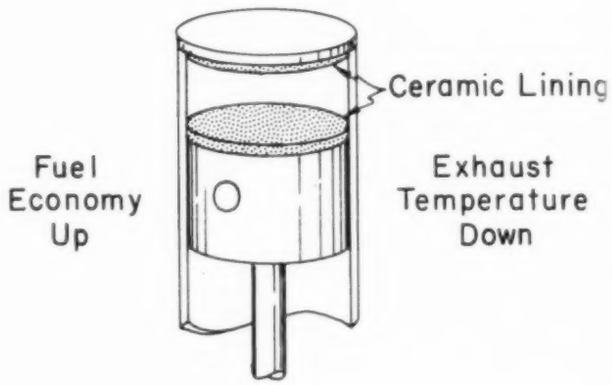
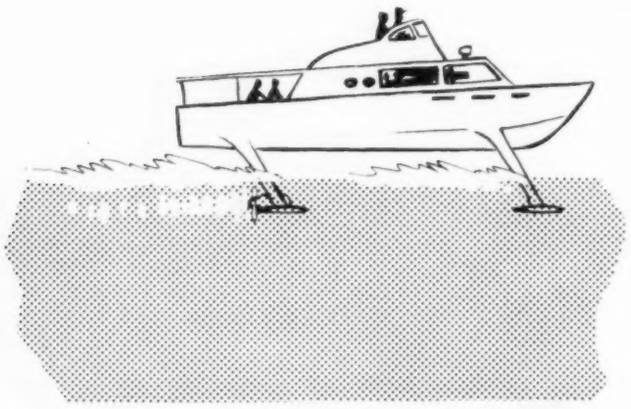
A ceramic lining—on piston and engine heads—has reduced the percentage of unburned hydrocarbons in diesel-engine exhaust. The ceramic is sprayed on to a thickness of 4/1000 of an inch. It is a souped-up mixture which can withstand temperatures in excess of 5000° F.

What are the advantages? There's less gummy deposit; less contamination in the lube oil and a boost in engine efficiency!



Boats—and Even Ocean-Going Liners May Move Up in the Air



There's a lot of work going on to elevate ships and boats above the rough action of the waves. One such craft—a ferry called the "Flying Fish"—is now plying between Puerto Rico and the Virgin Islands.

"Flying" above the surface on submerged wings or foils, this hydrofoil averages better than 35 miles per hour over this 70-mile span of ocean. The bouncing effect of the waves is eliminated.

At the same time, Russia is using similar ferries in the Black Sea and a number of U.S. companies are playing with the idea for design of large freighters and passenger liners.

Crew boats for offshore pipe line jobs and operations will likely see working models of this type craft in the near future.

Super Air Filter May Give Cleaner Gas

Stanford Research Institute has devised a filter based on a new method of building up filter mats. The method is quite simple. A solution of polystyrene in methylene-chloride solvent is sprayed into the air. The methylene-chloride evaporates, leaving thread-like fibers less than 1 micron thick and 1 micron long. These fibers are directed by the spray force against a two-foot square of Dacron mesh. The filter will pick up particles as small at 0.01 microns. Yet it offers reasonably low resistance to gas flow. It should find use in the gas industry.

Rules of Thumb

and Engineering Data Sheets for the Pipeliner's field notebook

$25 for Engineering Data Sheet $15 for Rule of Thumb

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Engineering Design

—63—Estimate hp required to compress natural gas.

To estimate the horsepower to compress a million cubic feet of gas per day, use the following formula:

$$\text{BHP/MMCfd} = \frac{R}{R + RJ}\left(\frac{5.16 + 124 \text{ Log } R}{0.97 - 0.03\,R}\right)$$

where R = compression ratio. Absolute discharge pressured divided by absolute suction pressure

J = Supercompressibility factor — assumed 0.022 per 100 psia. suction pressure.

Here is an example: How much horsepower should be installed to raise the pressure of 10 million cubic feet of gas per day from 185.3 psi to 985.3 psi?

This gives absolute pressures of 200 and 1000.

$$\text{Then } R = \frac{1000}{200} = 5.0$$

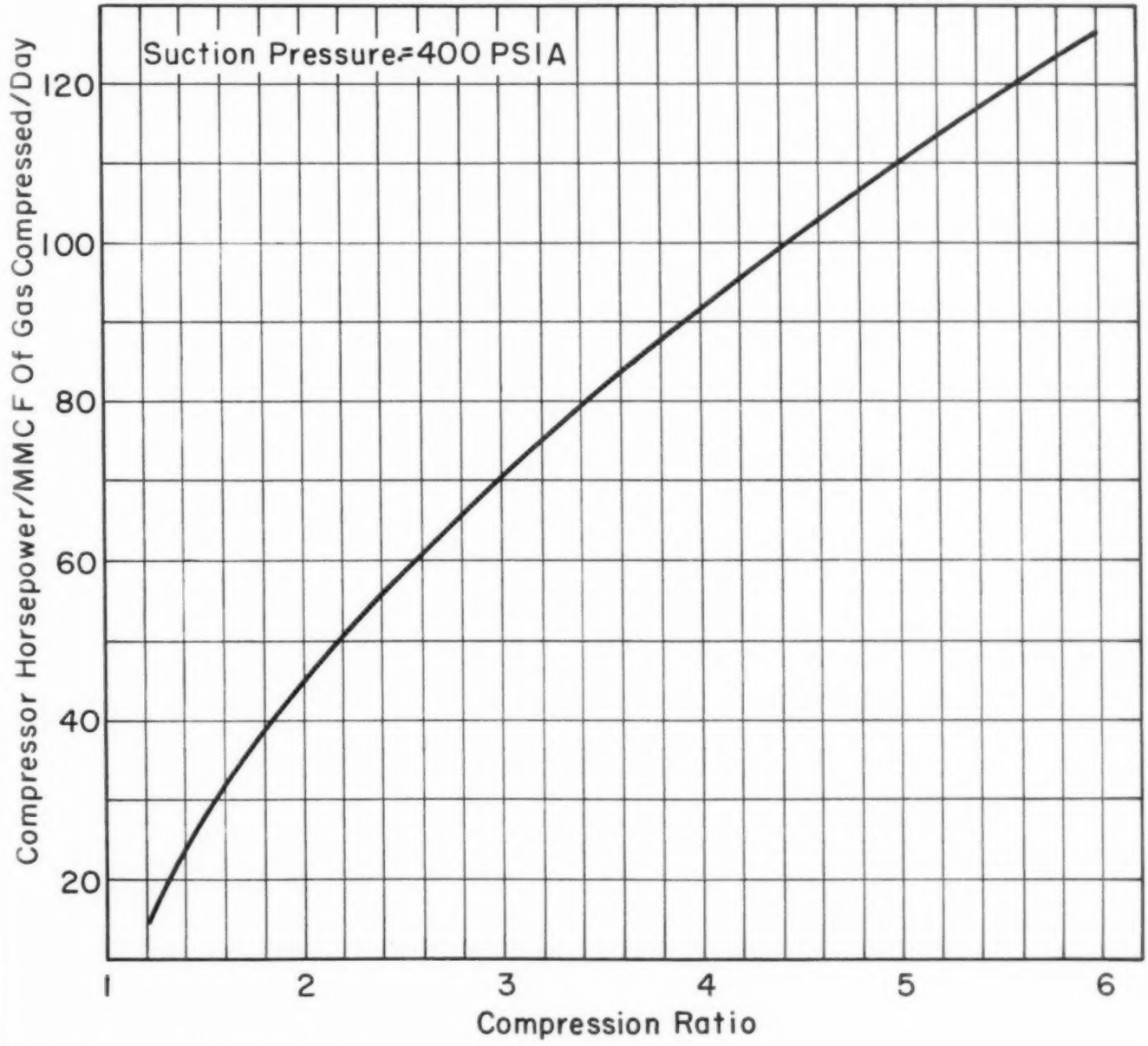
Substituting in the formula:

$$\text{BHP/MMcfd} = \frac{5.0}{5.0 + 5 \times 0.044} \times \frac{5.16 + 124 \times .699}{.97 - .03 \times 5}$$

$$= 106.5 \text{ hp} = \text{BHP for 10 MMcfd} = 1065 \text{ hp}$$

Where the suction pressure is about 400 psia, the brake horsepower per MMcfd can be read from the chart.

The above formula may be used to calculate horsepower requirements for various suction pressures and gas physical properties to plot a family of curves.



By
Pipe Line
Pete

IDEAS FOR THE FUTURE!

... in pipe line engineering, construction and operations

Look for Ceramic Linings in Reciprocating Engines

Armour Research Institute has been carrying out a research program designed to point the way to better days for railroads. One of the important discoveries made at the institute may point the way to better days for reciprocating engines.

A ceramic lining—on piston and engine heads—has reduced the percentage of unburned hydrocarbons in diesel-engine exhaust. The ceramic is sprayed on to a thickness of 4/1000 of an inch. It is a souped-up mixture which can withstand temperatures in excess of 5000° F.

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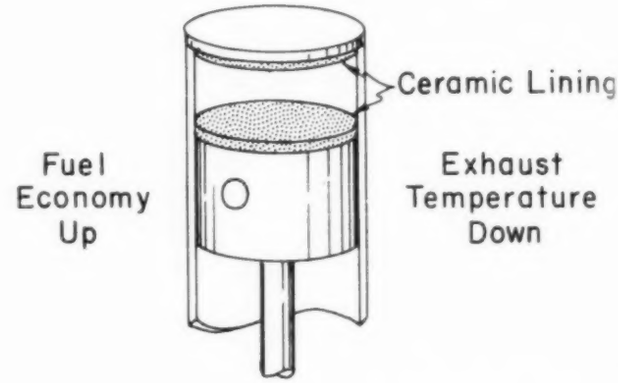

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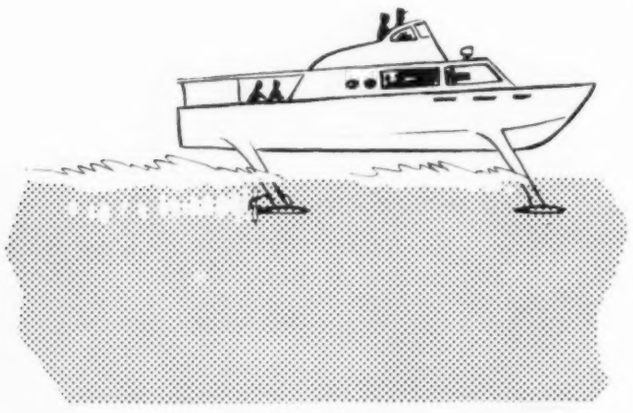

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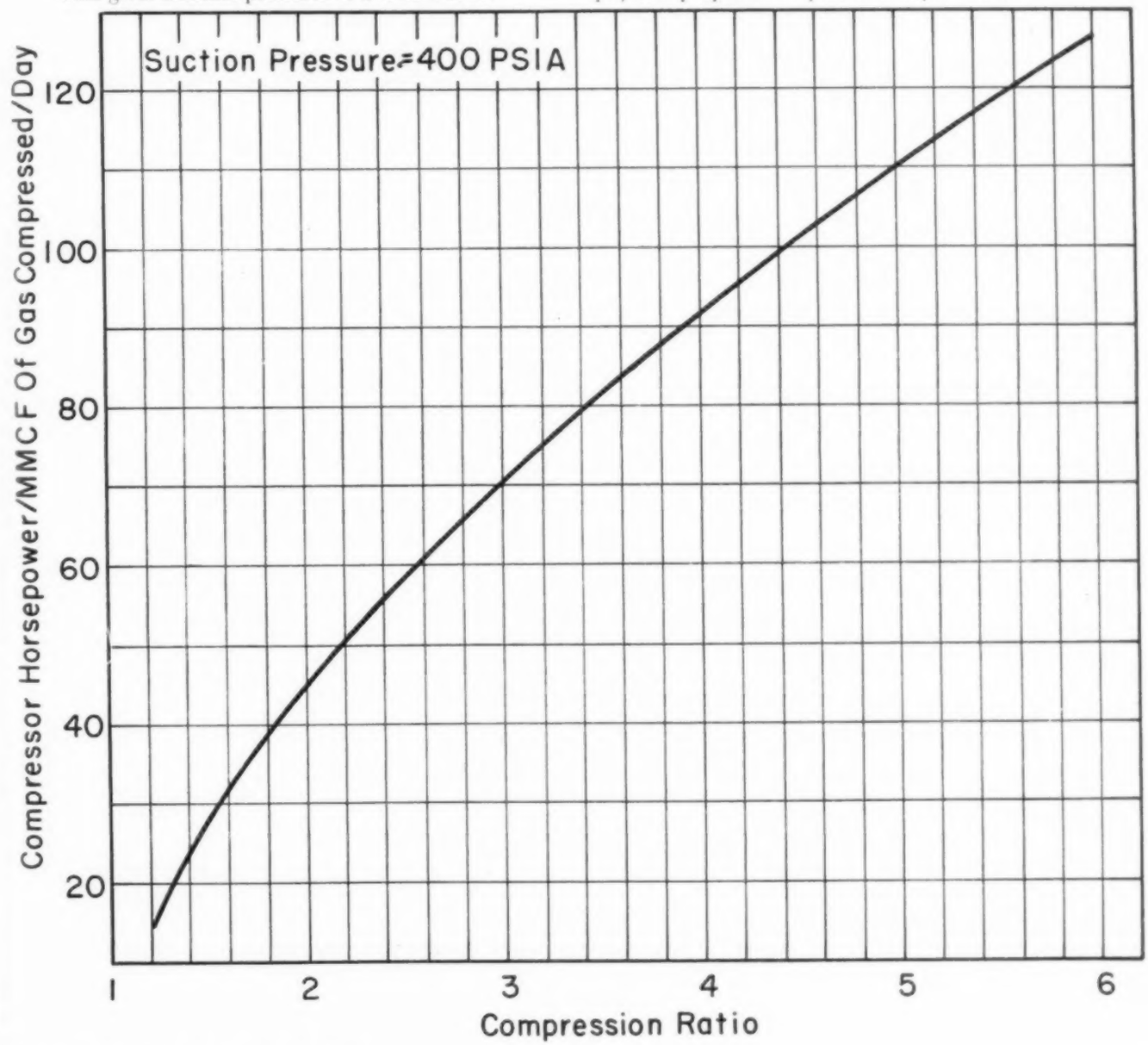
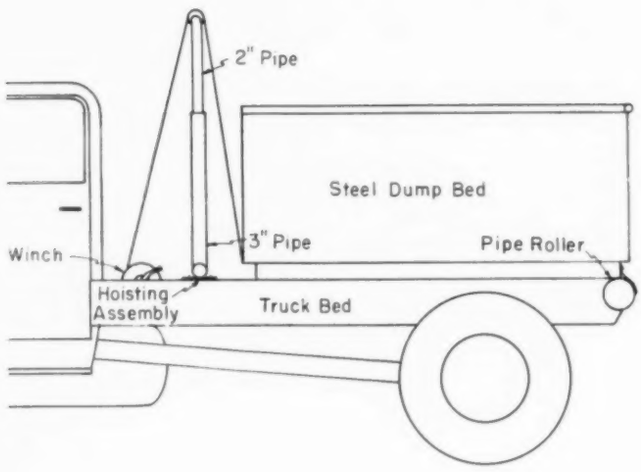


How to do it

PIPE LINE HINTS

$10 is paid for each illustrated acceptable contribution. Mail to The Editor, PIPE LINE INDUSTRY, P. O. Box 2608, Houston 1, Texas



Winch Truck Is Converted To Dump Truck at Low Cost

You never know what you'll be needing next on a pipe line job. Shown here are the plans one district maintenance gang used for converting a 2-ton gang truck to a sizeable dump truck. The resulting vehicle has a number of advantages over regular dump trucks. The primary one is that when the truck isn't needed as a dump truck, it can be easily and rapidly converted back to winch truck service.

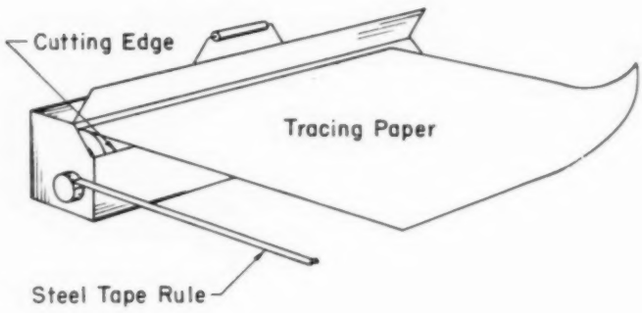
Luckily, in this case, there was an old gravel type dump bed available in a junk yard. This was purchased for $35. (Yet, it should be pointed out, that an inexpensive bed can be easily made of steel plate and pipe frame.)

The first problem was how to mount the dump bed on the winch truck so it could perform capably as a regular dump truck—yet be reconverted back to its normal function in short order.

The solution is shown in the drawing. Bolt the back end of the dump bed to the rolling tail gate. Note that holes were cut in the pipe roller. This allows the pipeliners to use wrenches in bolting the curved bearing plates to the roller.

The dumping mechanism centers around a dumping pole. This is made of telescoping joints of 2 and 3-inch pipe clamped to a bearing plate which can be bolted to the truck bed. Atop the pole there is a sheave through which the winch line is reaved. The tail chain and hook are hooked into the bottom of the bed.

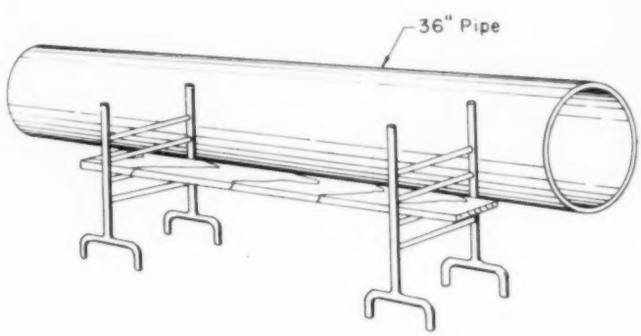
To reconvert the truck, the after-end of the dump bed is unbolted from the pipe roller, the front end lifted and allowed to slide from the truck. The dump pole is unbolted and stored.



Handy Rule for Draftsman Eases Work and Saves Time

The expense of drafting paper does not materially affect the value in the plant account, but if you've ever been a draftsman, you know that one of the vexing little jobs is measuring the correct amount of paper off a roll.

A simple solution to the problem is shown here. Mount an ordinary 6-foot steel tape on the side of the container, and to get the proper length paper, the draftsman needs only to pull the paper and rule out the proper distance. rip the paper across the cutting edge as shown.



Light Work Platform Aids Welder on 36-Inch Pipe

The pipe keeps getting bigger, the pressures higher and the steel more complex in its chemistry. This calls for more and more skill on the part of the welder.

One way to enhance a welder's skill is to provide him with a convenient work platform for the large diameter pipe. The one shown here is made of light aluminum with a 2 by 12 board running between the two upright members. The assembly easily rides from weld to weld. hooked onto the welding machine.

The framework of the upright members is made of 1-inch diameter tubing or steel pipe welded up as shown.

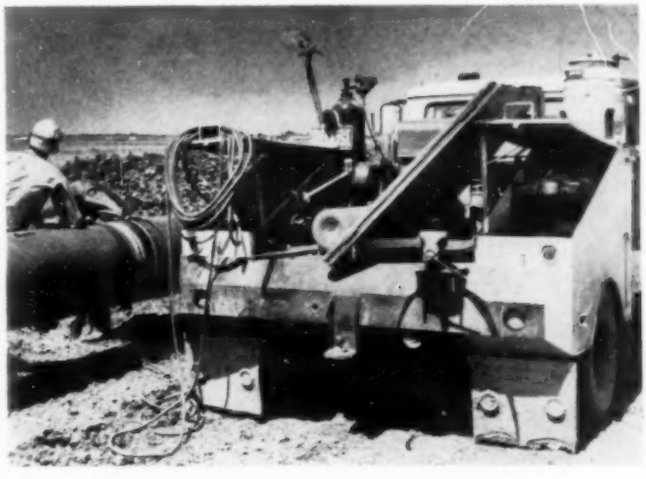
Rubber-Tired Dolly Eases Handling of Heavy Joints

Shown here is a rubber-tired pipe dolly made mostly of spare parts and scrap. With it, you can easily handle a heavy joint of pipe with safety!

Here's the way this particular dolly was made. Most of the materials came from behind the warehouse. The calipers came off a construction job; the two wheels were salvaged from an old welding machine and the 2-inch pipe, chain etc. was just outside the door.

To construct it, take a careful look at the picture. Notice that the ring on the calipers can slip on and off the 2-inch lever as desired.

To use this dolly, wheel it directly over the pipe, latch the calipers and bear down on the pipe handle. When the pipe is elevated to the desired height, boom down the handle with chain. Once secured, you're ready to "Mush!" with a ton of pipe or so!



Reels on Truck Bed Aid Rig Welder in Field Work

A rig welder on a spread in southeast Texas installed a set of three reels on his truck bed to hold and store welding cables during pipe line construction work. The reels, on ball-bearing shafts, sit in one of two storage compartment fabricated on the truck bed.

These simple reels allow a welder to pull off just enough cable to reach the joint. After completing the weld, he can quickly take up slack cable and move to the next joint. This speeds welding time and eliminates dragging cable along the ground.

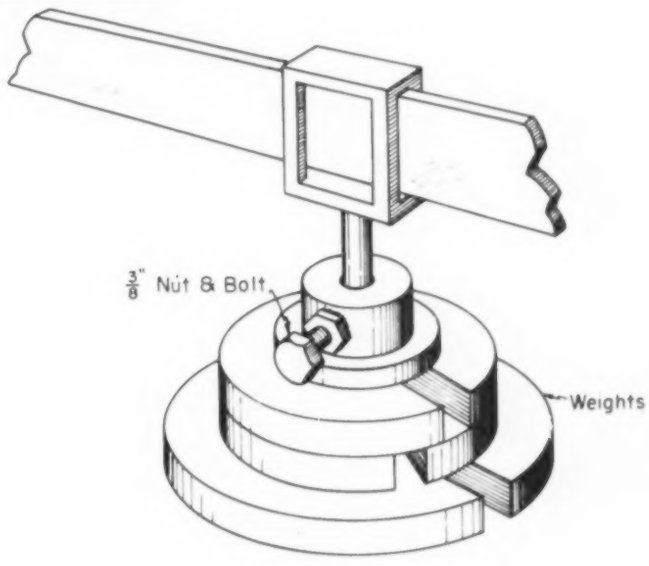
In the other storage compartment, welding rods, brushes and other equipment are stored. On the sides of each box are hooks to hold small tools. Between the metal boxes there is ample room for welder's wind boards, umbrella, and an extra gas bottle and small vise.

Clamp on Regulator Weights Solves Lost Weight Problem

A regulator that depends on weights for pressure settings—*had better not lose those weights!* Yet this can happen. Sometimes the lever arm pumps up and down and if a weight is lost, the pressure setting is changed!

Actually this problem is serious but quite easily solved. Just make a small clamp—using ¼-inch steel plate, ¾-inch pipe and a ⅜-inch set screw as shown in the drawing.

After this holder has been fabricated, slip it over the eye bolt on the regulator, and each time weights are added or removed, tighten this holder to clamp the weights onto the regulator.



WHAT'S HAPPENING

IN PIPE LINE CONSTRUCTION

By Donald G. DePugh, Construction Editor

Construction Progress On Humble Line

Construction is nearing completion on Humble Oil & Refining Company's 238-mile, 30-inch gas line from Corpus Christi to Clear Lake, Texas. Panama, Inc.'s lowering-in crew set pipe in ditch making a bend across the flat farmland of Texas coastal plain. The line is scheduled to be completed this month. It will tie-in with Humble's Clear Lake to Port Arthur, Texas line.

Midwestern Receives FPC Approval On 350-Mile Line to Chicago Area

Construction on the long-awaited Midwestern Gas Transmission Company 350-mile, 30-inch gas line from Portland, Tenn., to Joliet, Ill., will begin soon. The FPC approved Midwestern's plan and a companion application submitted by Tennessee Gas Transmission Company, Midwestern's parent firm.

Tennessee Gas was authorized to lay 157-miles, 36-inch loop lines in Louisiana, Mississippi and Tennessee and install an additional 114,900 hp at existing stations in Texas, Louisiana, Mississippi, and Tennessee at a cost of $61 million.

Included in Midwestern's $50 million program is construction of two stations with a total capacity of 14,300 hp. The system will interconnect with TGT's system at Portland and with Chicago District Pipe Line Company's line at Joliet. Chicago District Pipe Line Company is building a 50-mile, 36-inch line to Chicago.

Tennessee Gas recently let contracts on 200 miles of loop lines in Kentucky and West Virginia. Williams Brothers Company will lay 70 miles of 30-inch from Portland to Greensburg, Ky. H. C. Price Company has 58 miles of 30- and 26-inch in Kentucky and West Virginia and Western Pipe Line, Inc. will construct 72-miles, 30-inch, in Kentucky.

Midwestern has been trying to get approval on its line to the Chicago area since 1954. Another application by Midwestern is before the FPC presently. The proposal calls for a 504-mile, 24-inch line to bring gas from Manitoba, Canada, to Marshfield, Wis.

Bechtel Corporation is doing the field engineering and acquisition of right-of-way for construction on the Midwestern line.

Chicago District Awards Contract on 50-Mile Line

Chicago District Pipe Line Company has awarded a contract to Contracting & Material Company to lay approximately 50 miles of 36-inch gas line between Minooka and Chicago, Ill.

Construction To Start Soon On Marine Sulfur Pipe Line

Freeport Sulphur Company soon will begin work on its offshore sulfur pipe line from Grande Isle off Jefferson Parish, La.

The 7-mile, 6-inch line will be constructed by Sharman, Allen, Gay & Taylor Company. Several innovations in pipe line design are necessary to transport the sulfur through pipe.

The pipe line will be made up of three concentric lines. The 6-inch sulfur line will be encased in a 7⅝-inch hot water line, which will be inside a 14-inch protective casing. Ball bearing rollers will be attached to the smaller diameter pipes to ease construction problems.

The line will have an initial capacity of 4,500-long tons of sulfur per day; pressure at the mine end will be 900 psi. The 6-inch line will carry sulfur at about 320° F. and the 7⅝-inch line will carry hot water to help maintain the high temperature of the sulfur. Two lines will be attached to the outer line, one returning hot water to the mine and the other to carry fresh water to the mine.

Ashland Oil & Refining Plans 37-Mile Crude Line

Ashland Oil & Refining Company plans to lay a 37-mile, 6-inch crude line paralleling a section of its line from Green County, Ky., to Louisville. The new facilities will raise capacity of the line to 40,000-barrels daily.

Michigan Wisconsin Plans $24 Million Expansion Project

Michigan Wisconsin Pipe Line Company has filed an application with the FPC seeking permission to construct facilities costing $24 million.

Michigan would build 311 miles of gas lines in Wisconsin from Marshfield to Appleton and 66 miles in Illinois, Indiana and Michigan. There would also be a 5,280-hp compressor station at Marshfield and 23 measuring stations.

Michigan plans to take gas from Midwestern's proposed line extending from Canada to Marshfield.

Transcontinental Gas Pipe Line Corporation recently completed its third crossing of the Hudson River in New York. The twin 24-inch lines were laid in 160-foot sections and pulled across the bottom of the river. Two pipe supports, one 60 feet and the other 120 feet from shore, guided the pipe to the river bottom. Pipe trench was 20-feet wide and 25-feet deep, placing pipe 75-feet below mean low water level.

Leaving the launching ramp, the first section of dual lines is connected to cable which pulled the pipe from the New Jersey side of the Hudson. While construction was underway, day and night, patrol boats were used to transport personnel between shores and to prevent ships from anchoring near the pipe line trench.

Transcontinental Gas Pipe Line Corporation Completes Dual 24-Inch Crossing of Hudson River

Transcontinental Gas Pipe Line Corporation completed its third crossing of the Hudson River early last month.

Twin, 24-inch lines were laid across the 4,200-foot Hudson River from 72nd Street in Manhattan to North Bergen, N. J., by Samuel Galucci & Sons, Inc., and Collins Construction Company.

With a wall thickness of 0.500 inch, the pipe received a 1-inch coat of conventional mastic coating at a yard in Philadelphia, and an additional 2-inch jacket of concrete at the job site.

Pipe trench was 20-feet wide and 25-feet deep and the river was 50-feet below mean low tide. A special back-fill, consisting mostly of sand, was used.

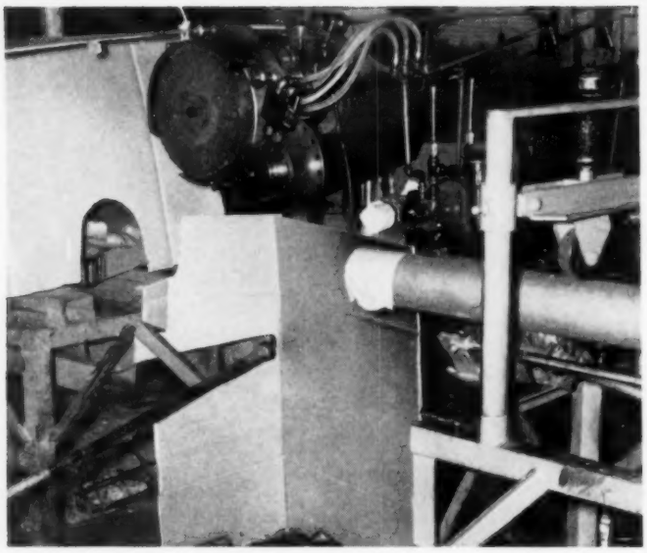
Galucci and Collins laid the lines in 160-foot sections. Sections were welded onshore, concrete coated and X-rayed and then launched into the water. At the launching ramps, set up to handle dual lines, pulling caps or "nose cones" were welded on the first section of pipe with a yoke and cable hooked onto the cone. The heavily coated pipe weighed 450 pounds per foot and 36 tons per 160-foot section. Pontoons were added to the pipe to aid in pulling it across the bottom of the wide river.

Other Transco crossings of the Hudson are at 134th Street and the Narrows of New York Harbor, from Staten Island to Brooklyn. The crossing links Transco's 1,840-mile gas line system from South Texas with New York.

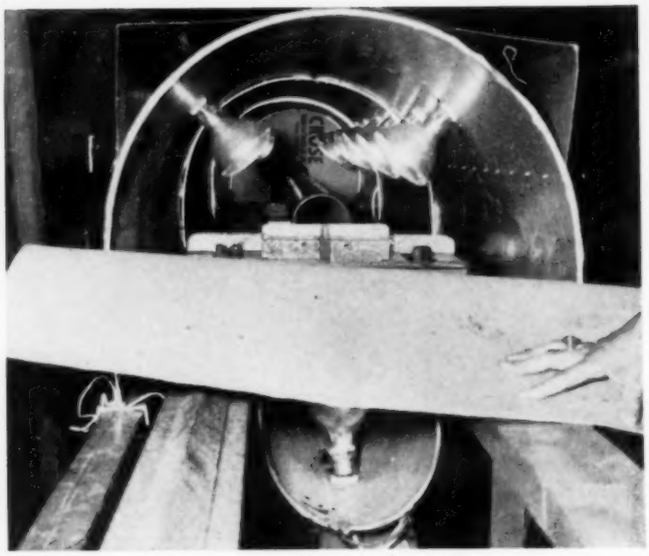
Increasing the capacity of Transco's New York delivery percent, the new lines tie in with a new Consolidated Edison Gas Company main line.

Welders in Transco's yard at 72nd Street, Manhattan, join 40-foot sections of 24-inch pipe for pulling operation across Hudson River. With a conventional mastic and concrete coating the 160-foot sections weighed 36 tons.

Twin 24-inch pipe lines reach North Bergen, N.J., shore after 4,200-foot crossing from Manhattan. The river crossing was part of Transco's $115 million expansion project started in 1958. The system carries gas from South Texas to New York.



Coal tar epoxy and catalyst, stored in separate containers, are fed to the transfer roller through small tubes. Transfer roller mixes coating materials and applies material to the rotating brush. Brush hurls coating on pipe as it passes under machine



and into curing oven. Pipe cures in 15 minutes under infra-red lights. Requiring no outer wrap, pipe is ready for pipe line ditch after 20-mil application.

Coal-Tar Epoxy External Coating Application Seen at Demonstration in Tulsa Yard During IPE

Pipeliners attending a recent demonstration at M. J. Crose Manufacturing Company in Tulsa got a preview of new coal tar epoxy coating and application technique.

Coating approximately 5 miles of 8-inch pipe for Signal Oil & Gas Company, Crose is applying a 20-mil coating in one application. Features of such a method include:

Coating requires no pre-mixing, instead the epoxy and catalyst are mixed in the coating machine just prior to being applied.

No outer wrap is required. Pipe is coated, cured and carried to job site.

Pipe and coating were preheated to 100°F. before coating was applied. The joint was moved by conventional conveyor under the coating machine and directly into the curing oven. A 15-minute cure under infra-red lights completed the process.

The coating machine consists of two parts, the transfer machine and a rotating brush. The transfer machine receives the coating materials, mixes them and transfers the final product onto the brush. The brush, located about 9 inches above the pipe, sprays epoxy on the rotating pipe.

A near 100 percent solid material, the coal tar epoxy reduces possibility of pinholes caused by solvent evaporation.

Transwestern Hit By FPC Examiner Decision

Federal Power Commission examiner David S. Lichtenstein has recommended that the FPC deny Transwestern Pipeline Company a certificate to build its 1,800-mile gas system from Texas-Oklahoma to California.

The decision of the examiner was based on the high price Transwestern will be paying for the gas and the unproved gas supply for Transwestern.

Transwestern's present proposal includes construction of a 670-mile, 30-inch main line from Roswell, N.M., to the California border near Topock, Ariz. Lateral lines would supply gas from Oklahoma and Texas Panhandles. Initial delivery of the $190 million system is scheduled for 300 MMcf of gas per day. Pacific Lighting Gas Supply Company, which will receive gas from Transwestern, plans a 128-mile 34-inch extension from Topock to Newberry, Calif.

Gas will be purchased from the Permian Basin area as well as Texas-Oklahoma areas.

Fulton-Banister Begins Work On Canadian Products Line

Fulton-Banister Ltd., has begun work on a 47-mile, 6-inch products line for Hudson's Bay Oil and Gas Company Limited in Alberta, Canada.

The line extends from Edson to the Windfall field. Construction of the line should be completed by the middle of July.

Contracts on 90 Miles Let To Shamrock Construction Co.

Contracts have been awarded to Shamrock Construction Company on 30 miles, 18 through 24-inch, for Ohio Fuel Gas Company and 60 miles of 2, 4, 12, and 20-inch for Dow Chemical Company.

The Ohio project consists of lines throughout several counties in Ohio and the Dow work will be in the vicinity of Midland, Mich.

El Paso Natural Lets Contract On 17 Miles of 4-Inch Pipe

El Paso Natural Gas Company has let a contract to Engineers Limited Pipe Line Company to construct 17 miles of 4-inch pipe line from Clarksdale to Chino Valley, Ariz.

Tentative Approval Received On Contract and Hiring Plan

A new contract and hiring plan for welders was agreed to at a meeting between the Pipe Line Contractors Association Labor Committee and the Negotiating Committee of the National Pipe Fitters Union in Dallas. The contract includes a new hiring arrangement for journeymen involving one central referral office in Tulsa.

As tentatively approved, the contract would go into effect June 15.

Okan Pipeline Co. Plans 28-Mile Line in Oklahoma

Okan Pipeline Company will build a 28-mile, 4-inch LPG-natural gasoline line in Oklahoma. The line will extend from its Mocane plant in Beaver County to the Liberal, Kan., station.

FPC Approves Trunkline's Major Expansion Program

Trunkline Gas Company received approval of its major gas expansion program from the FPC. Trunkline's expansion includes a 204-mile, 24-inch main line extension from Tuscola, Ill., to the Michigan-Indiana border, plus 500 miles of loops in Texas, Louisiana, and Illinois. Trunkline plans to complete construction on the $81 million project by the winter season.

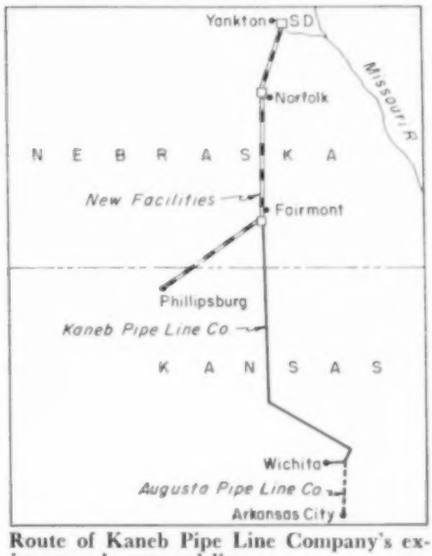
Kaneb Plans 279-Mile, 6-Inch Extension Of Products Pipe Line Into S. Dakota

Kaneb Pipe Line Company will start work this month on construction of 279 miles of 6-inch products main line extension and lateral lines in Kansas and Nebraska.

The main line extension runs 168 miles from the company's Fairmont terminal near Geneva, Neb., to a point near Yankton, S. D. A 111-mile lateral will extend from the Cooperative Refinery Association's refinery at Phillipsburg, Kan., to the Fairmont terminal. Kaneb's system presently consists of 246 miles of 8 and 10-inch from Wichita, Kan., area to Fairmont.

Included in the expansion program will be installation of two pump stations at Phillipsburg and Fairmont with modern multi-purpose terminals at Norfolk, Neb., and Yankton, S. D.

Pipe Line Technologists, Inc. has designed and will supervise construction and operation of the line. Construction should be completed by October of this year.



Route of Kaneb Pipe Line Company's existing and proposed line.

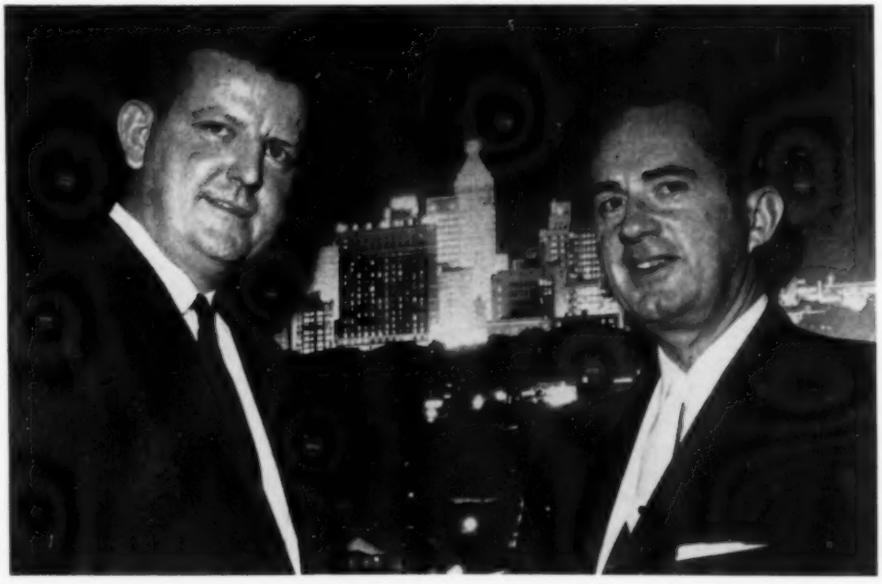
Houston Contracting Company Gets Monterey Pipe Line Work

Houston Contracting Company has been awarded a contract by Monterey Pipe Line Company to build approximately 23 miles of 8-inch, 12 miles of 14-inch and dual Mississippi River crossings in St. James and Lafourche parishes, La. Construction will begin around the middle of June.

Gulf Refining Company Sells Louisiana Gathering Lines

The Gulf Refining Company has sold 15 miles of gathering lines and a 30-mile, 8-inch pipe line extending from the producing area in the Citronelle field to Mobile, Ala.

G. H. Jett, Jett Drilling Company, and Bart B. Chamberlain, Jr., Mobile attorney and businessman, will operate the system as the Citronelle-Mobile Gathering System Company.



Allan Shivers Speaks to Tulsa Pipeliners

Allan Shivers, chairman of the board of Western Pipe Line, Inc., and former governor of Texas, spoke to Tulsa pipeliners at the Tulsa Pipeliners Club meeting May 19. Tom Chilton (left), Service Pipe Line Company, is president of the Tulsa club. Shivers stressed unity among industry members in fighting against federal government regulation.

Peoples Natural Gas Co. Lets Contract to Gentry

Peoples Natural Gas Company has awarded a contract to H. L. Gentry Construction Company to lay 22 miles of 24-inch from Waynesburg, Penn. to the West Virginia state line.

Creole Petroleum Company Plans 44-Mile Gas Line

Creole Petroleum Company plans to lay a 44-mile gas system near its Bachaquero 1 conservation plant on Lake Maracaibo, Venezuela. Included will be 17 miles of 30-inch and a 22-mile, 12-inch line from Bachaquero plant to Tia Juana 2 conservation plant.

PROPOSED PIPE LINE CONSTRUCTION

Here in convenient summary form is Pipe Line Industry's listing of company, line size, length, service, location and project status.

U. S.

Alaska Juneau Gold Mining Co., Los Angeles, 425 miles, 16-inch, gas, Oklahoma City area to St. Louis, planned.

Arkansas Industrial Pipeline Corp., Shreveport, 130 miles, 18-inch, gas, Perla-to-Helena, Ark., $9 million, planned.

Buckeye Pipe Line Company, New York, 70 miles, 8-inch, products, from Wayne to Flint, Michigan, contract let to R. L. Coolsalt Construction Co.

Chicago District Pipeline Company, 52 miles, 30-36 inch, gas, from Midwestern's proposed line at Joliet to Chicago, $13 million, contract let to Contracting & Material Co.

Coastal States Gas Producing Co., Corpus Christi, Texas, 289 miles, 14 and 18-inch main line and gathering system, McAllen to Falfurrias, Tex., area, and Lopena to La Salle County, $12 million, contract let on 95 miles to O. R. Burden Construction Corp.

60 miles, small diameter, gas gathering line, to tie in with system under construction and extend to Pearsall County, Texas, planned.

Coastal Transmission Corp., Houston, compressor station additions and new lateral lines, $6.2 million, before FPC.

Colorado Interstate Gas Co., Colorado Springs, 140 miles, gas, Green River, Wyo.-to-Provo, Utah; 109 miles, 26-inch, Texas Panhandle to southeastern Colorado; 136 miles, 34-inch, southeastern Colorado-to-Pueblo, Colo.; 107 miles, 30-inch, Pueblo-to-Denver, $91 million, before FPC.

Columbia Gulf Transmission Co., Houston, 12.8 miles, 6 and 20-inch, gas, loop line in Louisiana, $730,000, authorized.

Consumers Power Co., 126-miles, 26-inch, gas, main, Michigan-Indiana border to Plymouth, Mich., planned.

East Coast Pipeline Co., 90 miles, 12- to 24-inch, products, Linden, N. J. to Suffolk County, N. Y., $25 million, planned.

El Paso Natural Gas Company, El Paso, 244 miles, 30-inch, Permian-San Juan loops, planned.

69,240 hp in new and existing stations in Texas, Oklahoma, New Mexico and Utah, planned.

400 miles, 34-inch, Salt Lake City, Utah, to California border, planned.

Equitable Gas Company, Pittsburgh, Penn., 11.7 miles of storage pipe line and other facilities, $2,091,430, authorized.

Florida Pipeline & Storage Co., 54 miles, products, Port Everglades to Homestead Air Force Base, Fla., planned.

Freeport Sulphur Company, 7 miles, 6-inch, sulphur pipe line, from Grande Isle off Jefferson Parish, La., to mainland, contract let to Sharman, Allen, Gay & Taylor.

Gillette Pipeline Co., Cheyenne, Wyo., 103 miles, crude, from Dead Horse Creek field to Casper, Wyo., planned.

Great Northern Railway, St. Paul, 400-600 miles, 12-20 inch, crude, from Williston Basin to St. Paul-Minneapolis and Duluth-Superior areas, considered.

Gulf Resources, New York, 125 miles, gas, gathering system, from Lopena area in Zapata County to a point in La Salle County, Texas, planned.

Humble Oil & Refining Company, Houston, 116 miles, gas, gathering various sizes, southwest Texas, planned.

Iron Ranges Natural Gas Co., 115 miles, gas, from Itasca and St. Louis counties along route of Mesabi range from Grand Rapids to Aurora, Minn., $5 million, before FPC.

60 miles from Duluth to Silver Bay, Minn., before FPC.

Kaneb Pipe Line Company, 279 miles, 6-inch, products, main line extension and lateral, from Phillipsburg, Kan., to Yankton, S. D., planned.

Katy and New York Central Railroads, 2500-mile, 10-12 inch, LPG, from Houston, Texas, to New York, considered.

Michigan Wisconsin Pipe Line Co., Detroit, 311 miles, gas, Marshfield to Appleton, Wis., 66 miles, Illinois, Indiana, and Michigan, 5,280 hp station at Marshfield, $24 mililon, before FPC.

Midwestern Gas Transmission Co., Houston, 350 miles, 30-inch, gas, Portland, Tenn. to Joilet, Ill., $50.8 million, authorized.

350 miles, 24-inch, gas, from Minnesota-Canada border near Winnipeg to Marshfield, Wis., $52 million, before FPC.

Monterey Pipe Line Company, 35 miles, 8- and 14-inch, dual crossings of Mississippi River in St. James and Lafourche Parish, La., contract let to Houston Contracting Company.

New York State Natural Gas Co., Pittsburgh, 30 miles, 20-inch, gas, main, Silver Springs to East Elma, N. Y., $1.6 million, temporary FPC authorization.

43 miles, 20-inch, point west of Kittanning to Luthersburg, Penn, 14 miles, 26-inch, Little Marsh in Chatham Township to Boom station near Lawrenceville, Penn., and additional horsepower at Woodhull, Utica, N. Y., and Preston and Tonkin, Penn., contract let on 14 miles, 26-inch to Williams Bros. Co.

Northern Illinois Gas Company, 140 miles, 24-inch, gas, main line, East Dubuque to Des Plaines, Ill., planned.

Northern Natural Gas Company, Omaha, 46 miles, 30-inch, gas, loops, in Iowa, Nebraska, and Kansas; 18-miles, lateral extension, and 6,000 hp additions in Kansas, Nebraska, and Iowa, $8 million, authorized.

57 miles, gas, loops, Nebraska, Iowa, and Kansas, 8,000 hp additions in Kansas and Nebraska, $7.7 million, authorized.

171 miles, main line extensions, 66 miles, main loops, 139 miles, branch lines, 6,000 hp additions, to extend system from Minneapolis to Duluth-Superior area, $25.7 million, before FPC.

46 miles, main line extensions, 191 miles, loops, 1,767 miles, branch lines, and 45,400 additional hp, in Iowa, Minnesota, South Dakota, Nebraska, Wisconsin and Illinois, $76.7 million, before FPC.

Ohio Fuel Gas Co., 65 miles, gas, 4-24-inch main lines, in Belmont, Carroll, Cuyahoga, Fairfield, Logan, Lorain, Marion, Muskingum, Stark and Wayne counties, Ohio, $4.4 million, contract let on 30 miles to Shamrock Construction Co.

Okan Pipeline Company, 28 miles, 4-inch, LPG-natural gasoline, from Mocane plant in Beaver County to Liberal, Kan., station, planned.

Pacific Gas & Electric Co., San Francisco, 296 miles, 36-inch, gas, from Klamath Falls, Ore., to Antioch, Calif., southern section of line from Canada to California, before California Public Utilities Commission.

Pacific Gas Transmission Co., San Francisco, 614 miles, 36-inch, Kingsgate B.C. to Klamath, Ore., northern section of Canada to California line, before FPC.

Pacific Lighting Gas Supply Co., 128-mile, 34-inch, gas, main line from Topock, Ariz. to Newberry, Calif., authorized.

Pacific Northwest Pipeline Corp., Salt Lake City, 235 miles gas, gathering lines in San Juan Basin, Garmesa, Piceance Creek, and Big Piney Fields, $13.5 million, planned.

65 miles, gas, sales laterals in Washington, $1.5 million, planned.

Pennsylvania Gas Co., Warren, Penn., 38 miles, 8 and 10 inch, gas, in Erie and Warren Counties, Penn., and Chautauqua County, N. Y., $2.6 million, authorized.

Permian Basin Pipeline Company, Omaha, 83 miles, 16-inch, gas, from Pioneer's proposed facilities to Spraberry, Texas, and 3,960 hp compressor station, $5 million, before FPC.

Piedmont Gas Co., Hickory, N. C., 78 miles, 2-8 inch, gas, from connection with Transcontinental Gas Pipe Line to serve customers in North Carolina, $2.6 million, authorized.

Pioneer Gathering System, Inc., Amarillo, Texas, pipe line facilities in Texas costing $3.7 million, before FPC.

Pioneer Natural Gas Co., Amarillo, Texas, 62 miles, 10-inch main, Pampa, Texas, to Canyon, in Randall County, Texas, 20 miles, small diameter, gathering, 4,000 h.p. stations, $4.5 million, planned.

Phillips Petroleum Co., 25 miles, 6 to 20-inch, gas, South Eunice, New Mexico area, planned.

52 miles, 4 to 20-inch, gas, Gaines County, Texas, planned.

44-mile, 6-inch, products line, from Rocky pump stations to Amarillo, Texas, planned.

Rio Gas Gathering Co., San Antonio, 97 miles, 3 to 8-inch, gas gathering, South Texas, to supply gas to El Paso Natural Gas Company, planned.

Southern California and Southern Counties Gas Cos., Los Angeles, 200 miles, 34-inch, from Nevada-California border to point near Fullerton, Calif., $44 million, before Public Utilities Commission.

Southern Natural Gas Company, Birmingham, 190 miles, 16-24-inch, loop lines, gas, between Gwinville, Miss., and Wrens Ga; 62 miles, 14-inch, loops, along Atlanta-Macon line; 53 miles, 6⅝ to 14-inch, loops, along various branch lines. 3,140 additional hp at Gallion and Elmore, Ala. and Wrens, Ga. 60 miles, 20-inch, loops, in Louisiana between Franklington and White Castle and South of Toca. Lateral lines south of Gwinville and west to Cranfield field. 8,720 hp added at Franklinton, White Castle, Patterson and Brookhaven, before FPC.

200 miles, 30-inch, loops in Tennessee, Kentucky and West Virginia, contracts let to Williams Brothers, Western Pipe Line, Inc., and H. C. Price Co.

Tennessee Gas Pipe Line Co., Houston, 21 miles, 16-inch, 2 miles, 12¾-inch, gas, Louisiana coast, Vermillion, Blocks 46 and 64, $2.9 million, before FPC.

158 miles, 36-inch, looping system in Louisiana and Mississippi, to supply Midwestern additional gas at Portland, Tenn., $61.4 million, authorized.

Texas Eastern Transmission Corp., Shreveport, La., 267 miles, 14-30 inch, gas, Louisiana, Mississippi, Pennsylvania and New Jersey, $50 million, before FPC.

141,780 additional horsepower in existing stations, a new 2,200 hp compressor station, in Louisiana, Mississippi, Pennsylvania, Ohio, Kentucky and Tennessee, authorized.

65 miles, gas, Delmont, Penn., to Lambertville, N. J., before FPC.

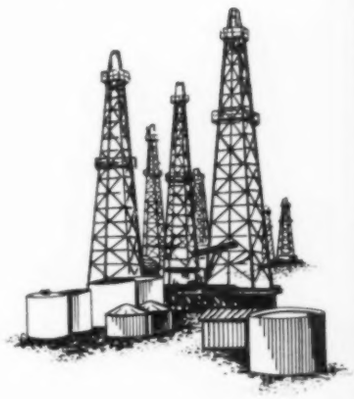
Texas Electric Service Company, Fort Worth, 300 miles, gas, Old Ocean field to Fort Worth, Texas, $25 million, considered.

Texas Gas Gathering Corp., Shreveport, 36.6 miles, gas, gathering system in Rodney Field, Jefferson County, Miss. and from North and South Locust Ridge, Lake St. John Field in Tensas and Concordia parishes, La., $855,413, before FPC.

Texas Gas Transmission Corporation, 246 miles, 26-30-inch, loops, between Eunice, La., and Lebanon, Ohio, 102 miles, supply lines, south Louisiana, and addition of 15,760 hp, $40 million, before FPC.

Continued on Page 82

CORROSION IN WATER FLOOD PIPE LINES?



WATER FLOOD PIPE LINES can be protected from corrosive waters.

CEMENT MORTAR LINING of water flood lines can be done "in place."

WHERE CORROSIVE WATER is causing too frequent water line problems, Cement Mortar Lining is your answer.

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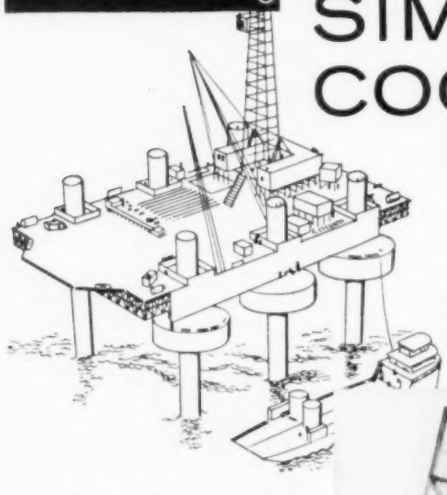
For more data on advertised products, use Readers' Service Cards, last page.

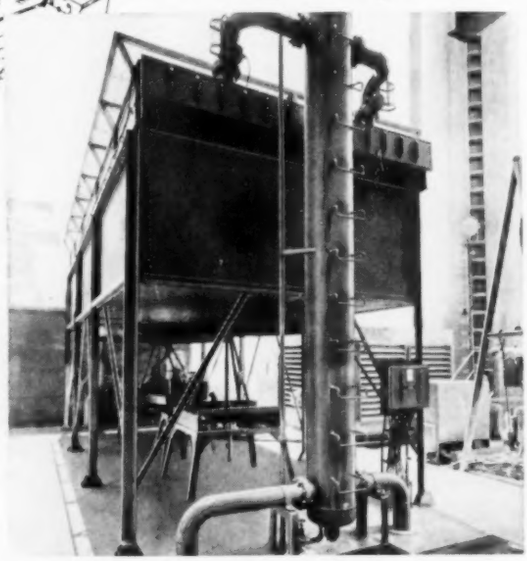
HC HORIZONTAL CORE UNIT by Young

SIMPLIFIES COOLING of POWER UNITS

on Giant Offshore Drilling Barge...



Placid Oil Drilling Barge Operates in 106' of Water, off Eugene Island, La., U.S.A.



Closed fresh water system cools 8 500 hp Diesel Engines in Constant Operation

Every possible Young Quality advantage has been built into the cooling system of the power units of this Placid Oil Company's 8750 ton drilling barge. The eight 500 hp Diesel engines which generate all the required AC and DC power have a consolidated cooling system piped into a compact, efficiently designed Young H-C 2610 Horizontal Atmospheric Cooler. As in many installations, continuous operation is a must; downtime is costly and cannot be countenanced. All components are designed for maximum efficiency and rugged dependability ... to give continuous performance twenty-four hours a day.

Each installation is treated as a separate cooling problem by Young Heat Transfer Specialists. If you have a Heat Transfer Problem, or if you are anticipating one, consult with Young representatives. No obligation, of course.

OIL FIELD AND PIPELINE REPRESENTATIVES

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6. J. R. Meek Company Tulsa, Okla., Houston, Tex.
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PROPOSED CONSTRUCTION

continued

Texas Illinois Gas Pipeline Company, Chicago, 16,000 additional hp to stations at Lufkin, and Marshall, Texas; Texarkana, Malvern, Searcy, and Biggers, Ark.; Jackson, Mo.; and Hammond. Ill., $3.9 million, before FPC.

Transcontinental Gas Pipe Line Corp., Houston. 149 miles, 36-inch, main loops. 34 miles, 20, 24-inch gathering, compressor stations at Nueces County, Texas and St. Helena Parish, La., additional hp in eight stations, $51 million, before FPC.

90 miles, 10-16-inch, Louisiana coast off Cameron to Blk. 10, Mosquito Bayou to Ship Shoal Blk. 28, and Eugene Island Blks. 129, 172, 184, contract let to Brown & Root.

Transwestern Pipeline Company, Houston, 1,305 miles, 24- and 30-inch, gas, main line, from West Texas and Oklahoma-Texas Panhandle area to Topock, Ariz., $193 million, before FPC.

Trunkline Gas Company, Houston, 204 miles, 26-inch, gas, main line from Tuscola, Ill., to Michigan-Indiana border; 464 miles, 30-inch loops between Longville, La., and Tuscola and 45 miles, 24-inch, in Texas, 183 miles gathering, Louisiana, 3000 additional hp at Longville station, $81.5 million, authorized.

Underground Storage & Exploration, Upper Darby, Penn., 394 miles, 12-inch LPG, from Moundsville, W. Va. to Newark, N. J., $9 million, approved.

95 miles, 6-8 inch, laterals to Mauch Chunk, Penn., and to Philadelphia, planned.

Valley Gas Transmission, Inc., Houston, 160 miles, 3 to 8-inch, gas, gathering, in Hidalgo, Brooks, Starr and Jim Wells Counties, Texas, $15 million, before FPC.

Wilcox Crude Oil Corp., Shreveport, La., 20 miles, crude line in east central Louisiana, $500,000, planned.

International

ACT Oils, Ltd., Montreal, 400 miles, crude, Dawson Creek, B. C., to Bella Coola, B. C., before B. C. government.

Alaska-Yukon Refiners and Distributors, Ltd., Edmonton, Alta., 150 miles, products, serving Alaska and Yukon territory, $3.5 million, planned.

Alberta Natural Gas Company (Jointly owned by Westcoast Transmission Co. and Alberta & Southern Gas Co. Ltd.) 36-inch, gas, Alberta border to British Columbia-Idaho border, supply gas to Pacific Gas & Electric Co., $40 million, planned.

Arab League Oil Committee, large diameter crude line from Persian Gulf to Mediterranean Coast, $500 million, considered.

Aurine Alps Railway & Pipeline, 200 miles, crude, Venice to Munich, Germany, considered.

Bituminous Oil Pipeline Co., Calgary, 250 miles, crude, from Athabasca tar sand plant in northeastern Alberta to Edmonton, approved.

Burmah Oil Co., Ltd., 850 miles, crude, 20 inch, from Nahorkatiya to Calcutta, India, planned.

Cartier Gas Corp. (St. Maurice Gas, Inc., and Consumers Gas Co., Toronto), 170 miles, gas, Montreal to Quebec City, planned.

Colombian Petroleum Company, 68 miles, 12-inch, crude, Cicuco field to Covenas, planned.

Consolidated Gathering Systems, Ltd., Calgary, 198 miles, crude, Sturgeon field to Edmonton, planned.

Creole Petroleum Co., 44 miles, 12-30-inch, gas, Bachaquero to Tia Juana, Venezuela, planned.

Development and Resources Corp., 70 miles, 8 inch, gas, from Agha Jari oil field to Ahwaz, Iran, planned.

Entre Nazionali Idrocarburi, Rome, Italy, crude, from Qum field in Iran to the Mediterranean Sea, considered.

Foothills Pipe Line, Ltd., 500 miles, 12 to 16-inch, LPG, from Alberta to Pacific Coast, $80 million, considered.

Gibson Crude Oil Purchasing Co. Ltd., 170 miles, crude, Milligan Creek, B. C. to Grande Prairie, Alta., planned.

Hudson's Bay Oil and Gas Company, Ltd., 47 miles, 6-inch, products, Edson to Windfall field, Alberta, contract let to Fulton Banister Ltd.

Hydrocarbons Pipeline, Ltd., Winnipeg, Manitoba, 880 miles, 6-8 inch, products, from Edmonton to Winnipeg, $35 million, partial authorization.

Independent Pipe Line Co., 2,019 miles, 34-36-inch, crude, Edmonton to Montreal, 23,000 pump horsepower, $395 million, before Borden Commission.

Interprovincial Pipe Line Company, 350-mile extension from Toronto to Montreal, looping line from Edmonton to Toronto, crude, $240 million, considered.

6,150 hp pump station at Iron River, Mich., and 4,450 hp addition at Edmonton, Alta., $2 million, planned.

Iraq Petroleum Company, 80 miles, 30-32-inch, crude, loop line, Rumaila field to Fao, Iraq, planned.

Island Transmission Company Limited, Nanaimo, B.C., 25 miles, 10-inch, gas, from point near Vancouver, B.C. to Vancouver Island, 67 miles, 10-inch, laterals to Victoria and Nanaimo, B.C., $14 million, planned.

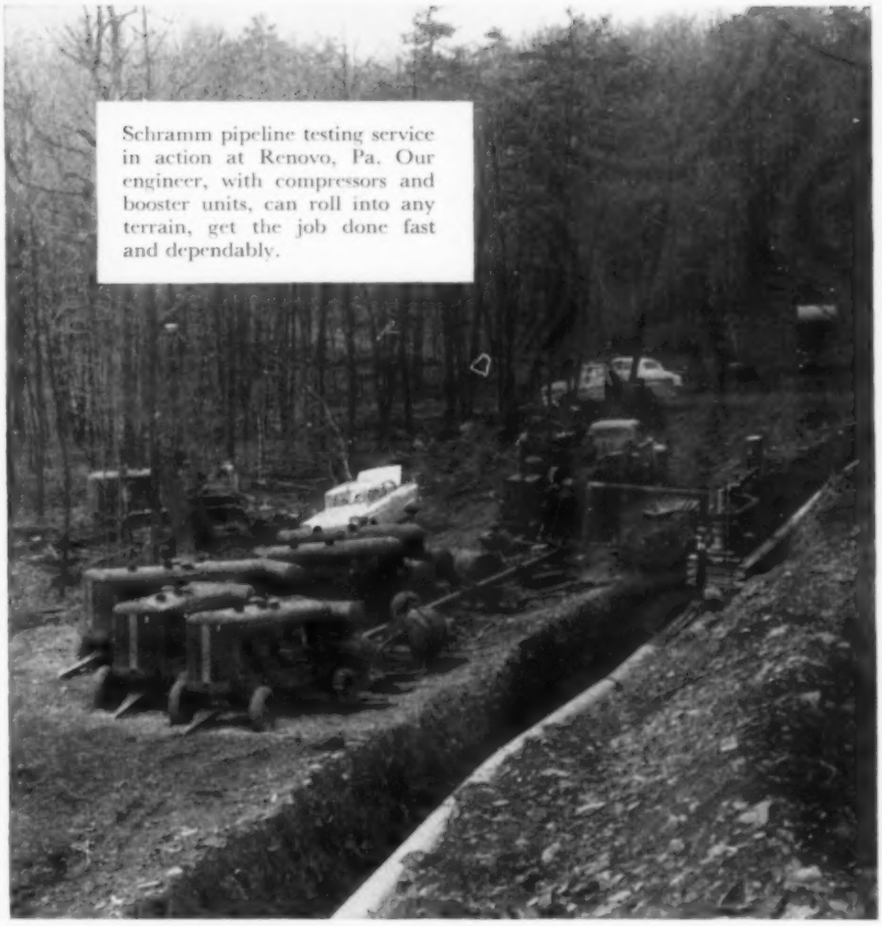
Mid-Continent Pipe Lines, Ltd., 1500-mile, 30-inch crude, Edmonton to Chicago, planned.

NATO, 211 miles, crude, 6-inch, between Malatya-Cetinkaya-Erzincan, Turkey, $6 million, bids asked.

National Iranian Oil Co., 146 miles, 6 inch, crude, from Azna to Isfahan, Iran, $5 million, planned.

1000 miles, 38 inch, crude, from central Iran to the Turkish Mediterranean coast, considered.

Continued on Page 84



Schramm pipeline testing service in action at Renovo, Pa. Our engineer, with compressors and booster units, can roll into any terrain, get the job done fast and dependably.

NOW, SLASH PIPELINE COSTS WITH NEW SCHRAMM SERVICE:

Test pipelines with compressed air

Close-up view of boosters shows part of manifold and air line leading into the pipe being tested.

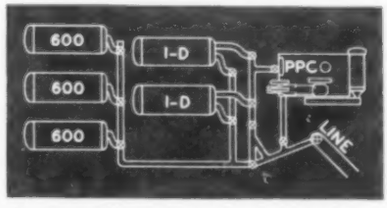


Diagram illustrates piping connections and positions of Compressors and Boosters.

Now pipeline testing is easier, "cleaner", cheaper—with Schramm pneumatic testing service. At Renovo, Pa., for example, Schramm equipment tested approximately 36 miles of a 24" line to a pressure of 1380 psi, *operating 648 hours without stopping!* Compressed air gives constant pressure over the entire line (including grades), with a constant test figure. There is no problem of supplying or disposing of water, and lines are clean and ready to flow the minute testing is completed.

Rent or buy what you need

Schramm can rent or sell you everything you need: three Schramm 600 cfm Portable Compressors, two 1-D Boosters and one PPC Booster make up the package seen above. Package goes anywhere, operates to 1500 psi.

Schramm Pipeline Testing Service is complete—right down to the engineer who supervises the job from start to finish. We deliver to your test site, or you can furnish your own transport.

Schramm pneumatic pipeline testing is a proved success. Already paying off for contractors across the country. Write today for your own estimating chart.

See the Yellow Pages for local Sales, Service and Rentals of Schramm Air Compressors.

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MANUFACTURERS OF AIR COMPRESSORS

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PROPOSED CONSTRUCTION

continued

Peace River Oil Pipe Line Co., Ltd., 70-mile, crude, Swan Hills to Iosegun Junction, approved.

230 miles, 8-inch, crude gathering, from fields in northeast British Columbia to Dawson Creek, B. C., and Grande Prairie, Alta., and to existing lines at Sturgeon Lake, $8.5 million, planned.

Pembina Pipe Line, Ltd., Edmonton, 1,200 miles, LPG, from Alberta gas fields to eastern Canada, planned.

Petroleos Mexicanos, 38 miles, 4 inch, products, from Mexico City to Toluca, $500,000 planned.

126 miles, 4, 6 and 8 inch, products, from Mexico City to Cuernavaca and Puebla, $2.5 million, planned.

214 miles, products, Monterrey to Torreon, $6.5 million, planned.

Pipelines of Puerto Rico, Inc., 95 miles, 8-inch, products, Penuelas to San Juan, Puerto Rico, planned.

Sociedad Nacional de Oleoductor, 75 miles, crude, from Santiago-to-Valparaiso, $3 million, planned.

Societa Nazionale Metanodotti, 250 miles, 18-inch, crude and products, Genoa to Milan-Cremona-Torino, Italy, and Geneva, Switzerland, considered.

Sui Gas Transmission Co., Multan, Punjab, India, 145 miles, 8-inch, gas, from Sylhet to Dacca, East Pakistan, $9 million, considered.

130 miles, 16-inch, gas, main line, Multan to Lyallpur, planned.

Trans-Canada Pipe Lines Limited, Toronto, compressor stations at Ignace, Geraldton and Hearst, Northern Ontario, and Maple, north of Toronto, $15.5 million, planned.

Trans-Europe Pipe Line, 700 miles, 30 inch, main trunk, crude, from Mediterranean to northern Europe, considered.

Trans-Prairie Pipelines, Ltd., Edmonton, crude line, from Weyburn field to Regina-Moose Jaw areas, $5 million, considered.

Union Gas Company of Canada Limited, 45 miles, 8-inch, gas, main, Stratford to Goderich, Ontario; 10-miles, 8-inch, main, to Amhertburg; 10-miles, 12-inch, lateral, Galt to Brantford, planned.

Venezuela Sun Oil Co., 18-inch crude line In Lake Maracaibo, contract let to J. Ray McDermott & Co.

Westcoast Transmission Company, Ltd., 174 miles, 30-inch, gas, Savanna Creek gas field, Alberta, to British Columbian border, $45 million, planned.

Williams-McWilliams Industries, Inc., New York, 441 miles, 6-inch, crude, Villa Montes, Bolivia to Villa Hayes, Paraguay, considered.

Yacimientos Petroliferos Fiscales, Buenos Aires, Argentina, 621 miles, 12-inch, products, Mendoza to San Lorenzo, Argentina, $19 million, planned.

281 miles, 12¾ inch, crude, Pichana to San Miguel Tucuman to Techint S. A., planned.

450 miles, 16-inch, crude, from Neuquen Province to Bahia Blanca, planned

ON THE LINE

Kennedy Bill Would Affect Contracts

The Labor Management Reporting and Disclosure Act of 1959, better known as the Kennedy Bill, presently before the House of Representatives, would affect pipe line contracts directly. In its present form, the bill provides that a contract between a contractor and a union could require, as a condition of employment, membership in the union after 7 days instead of after 30 days as the law now requires. The bill does, however, provide that this rule shall not supersede right-to-work laws in those states which have them.

This bill would also specifically approve payment of money by an employer or group of employers to a trust fund for apprentice training purposes; present law is not clear on this point.

CUT MAINTENANCE COSTS —

SWITCH TO CROSE EQUIPMENT!

Crose pipeline construction equipment has an international reputation for ruggedness and dependability. Your maintenance costs will be lower when you use Crose equipment — the most complete line ever offered.

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Tuffy® Tips —on safe use of Slings and Hoist Lines

Safety Council Cites Factors In Lifting Injuries

The National Safety Council points out that nearly a fourth of all compensation cases are the result of unsafe handling methods or conditions, and lists the following as factors contributing to handling injuries:

"(a) Handling loads that are too heavy; (b) lifting or lowering with the back muscles instead of the leg muscles; (c) handling load with an insecure grip and failing to watch where hands are placed; (d) handling without sufficient help or failing to use mechanical equipment; (e) handling before getting a firm footing; (f) lifting or lowering with a jerking, twisting movement of the body, or when the body is in an awkward position."

Maintenance Tips for Hoisting Equipment

(1) Be sure crane and hoist controls are in proper working order. Don't use equipment that hasn't been tested recently.

(2) Inspect hitching equipment before it is used. Recheck after use.

(3) Remove hitching equipment not in use from hooks, hoists and loads. Don't allow it to remain loose.

(4) Store slings systematically when they're not in use. Don't let them lie around helter-skelter. They may be damaged between lifts.

Proper Sling Fittings Assure Greatest Safety and Efficiency

Fittings used on Tuffy Slings are of the most improved types and are factory-fitted on the Tuffy Sling you order. Or, if you prefer, you can fit them in your rigging loft. Shown here are two of these Tuffy Sling fittings.

Newco Gripper Sling Hook:

Fitted with a spring that bears against the sling. This holds slide hook at any position on sling, thus preventing it from sliding down to the sling eye each time it is unhitched. Easily positioned for each new load. Hook readily chokes into position when load is applied.

Sliding Hook

The smoothly rounded saddle slides on the sling leg with minimum wear to tighten on the load. Made of extraordinarily tough manganese steel to afford an ample factor of safety on rated loads. Designed with steel distributed in relation to stress lines.

Tuffy Hoist Line: Perfect Team Mate for Tuffy Slings

Tuffy Hoist Line is a special rope construction for use on all types of overhead cranes, derricks and clamshells. It has the right combination of strength, flexibility and toughness for greatest safety and longest life in its wide range of uses.

See Your Tuffy Distributor for the Most in Sling and Wire Rope Service

Ferrule Safety is a Part of Sling Safety

The steel ferrule is applied under tremendous pressure. It holds so tight that the eye splice has 100% of fabric strength. It's smoothly tapered to meet the main body of the sling. No abrupt edges or sharp projections. The extra quality and safety of Tuffy's pressed-on ferrule is yours at no extra cost.

Tuffy Braided Wire Fabric: Successor to Wire Rope in Slings

The secret of the extra strength and greater flexibility of Tuffy Slings is also the secret of their greater safety. It's the exclusive, patented, machine-braided fabric. You won't find it in any other sling. It means longer sling life, easier handling and greater ability to take deadloads, shocks and impact with safety.

Kinks Can't Hurt a Tuffy Sling

One of the first rules of ordinary wire rope safety: never use a sling that has been kinked. The wires are permanently bent, damaged and weakened. Not so with Tuffy Slings. Tuffy's patented, 9-part machine-braided fabric is just about impossible to kink. And if it does, under some unusual condition, you can straighten out the kink with ease—leaving no material damage.

FREE! New Tuffy Sling Handbook

Revised and enlarged edition. Covers slings from A to Z. Gives types, dimensions, weights, rated loads, proper fittings. Even includes safety-approved standard signals used in operation of various equipment. Send for your free copy now. Address **Union Wire Rope Corporation, 2278 Manchester Ave., Kansas City 26, Mo.** Specialists in high-carbon wire, wire rope, braided wire fabric and stress relieved wire and strand.

UNION Wire Rope

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Pipe Line School

Participants in the annual Pipe Line Technology School, held at Lee College, Baytown, Texas, included 29 persons from the United States and several foreign countries. Shown at left are several of the students during a demonstration on the use of pipe line pigs for sealing a line to make repairs. The six-weeks school which ran through May 21, is operated by The University of Texas Petroleum Extension Service under the sponsorship of API's Committe on Personnel Training, Division of Transportation. Curriculum consists of lectures, demonstrations, discussions, and field trips. Directors of the school are James Conway, Petroleum Extension Service, The University of Texas, and Russell Brannon, Humble Pipe Line Company.

More Know-How Needed

"Management people in business and government need a far greater understanding of technology than they now have," Willard F. Rockwell, Jr., president of Rockwell Manufacturing Company, told the opening session of the 21st American Power Conference March 31 at Chicago.

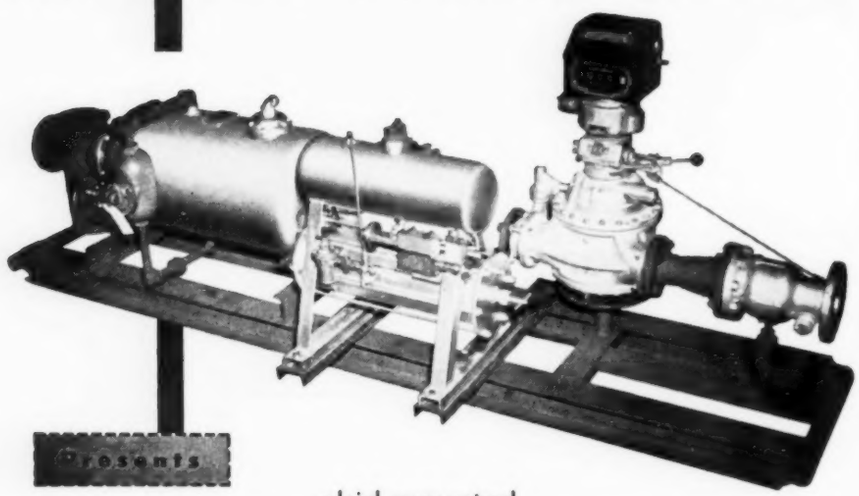
Talking before the gathering of power engineers, he added, ". . . nontechnically trained management people are called upon to make decisions without sufficient background to take adequate account of their technical environment."

He called on engineers and engineering educators to initiate courses in technology for students in nontechnical schools and for practicing management personnel. "Those in the best position to see the need," he warned, "must be the first to act."

Oil Remains Prime Fuel Source

Hydrocarbon fuels will continue to be our primary source of energy through this century, predicts J. B. Macauley, deputy director, Defense Research & Engineering. He told WPRA members at the 47th annual meeting that (1) the military is searching for an omnivorous engine that could use varied fuels, (2) it is unlikely that military octane requirements will increase "substantially," (3) that nuclear fuel will be used on all submarines and "a few surface ships but isn't imminent for ground vehicles or even aircrafts, and (4) that future plans call for running naval gas turbine and diesel engines on distillate fuels. He added that the space age will usher in many new lubricant problems, and that regarding propellants "there is a noticeable increase in attention to storable liquids of late."

MECO Integrated SERVICE



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AUTOMATIC CRUDE OIL METERING ASSEMBLY

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Unit automatically shuts down after allowable has been flowed, with volume corrected to 60°F and registered on counter and/or ticket.

MECO sampler stores sample at line pressure.

Air and non-condensible gases are automatically separated from liquid and vented. Metering of gases is prevented.

Unit includes line-size strainer • SMITH line-size deaerator • float-operated pilot and safety shut-down valve • MECO proportional sampler • A. O. Smith positive displacement liquid meter • SMITH set stop valve.

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New... triple-purpose anti-icer

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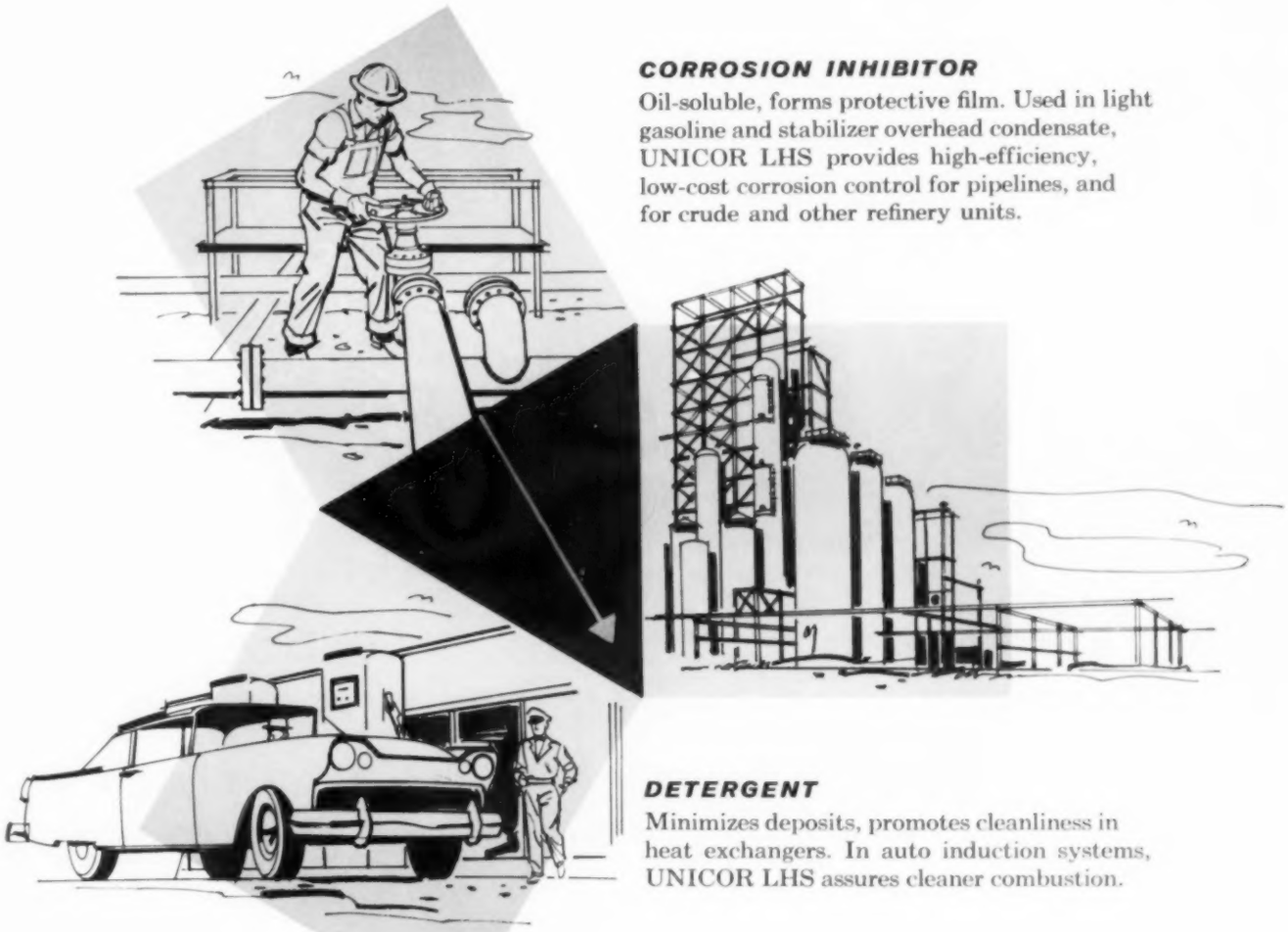
provides valuable refinery and pipeline service, too!



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Oil-soluble, forms protective film. Used in light gasoline and stabilizer overhead condensate, UNICOR LHS provides high-efficiency, low-cost corrosion control for pipelines, and for crude and other refinery units.

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Minimizes deposits, promotes cleanliness in heat exchangers. In auto induction systems, UNICOR LHS assures cleaner combustion.

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Highly effective safeguard against carburetor icing, prevents stalling. UNICOR LHS is convenient and economical to use, and is instantly miscible in lightest components of winter-grade gasolines.

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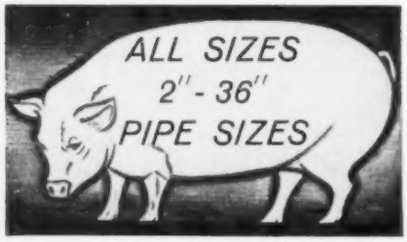
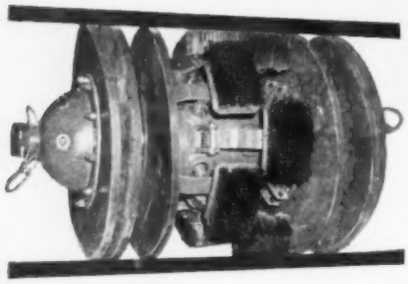


ANY COMBINATION ALWAYS IN STOCK



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Especially designed for use on dual diameter lines and lines with small I. D. full opening valves within collapsible range. Sturdily built of lightweight aluminum castings with spring loaded brushes and collapsible rubber discs, the S-18 assures maximum cleaning action.

COLLAPSIBLE SIZES: 36" to 30", 30" to 24", 24" to 20" and 20" to 18".

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What's Happening among MEN in the INDUSTRY

PIEA Officers Elected

The Petroleum Industrial Electrical Association elected new officers for 1959-60 at its recent convention in Galveston. New officers are, seated, left to right, Delbert R. Wofford, Texas Gas Transmission Corporation, president; C. E. Upson, Texas Illinois Natural Gas Pipeline Company, vice president; E. B. Dunn, Atlantic Pipe Line Company, secretary-treasurer; and E. H. Wilder, Sun Oil Company, chairman of the board. The directors include, standing, left to right, L. E. Cook, Sinclair Pipe Line Company; Clifton D. Campbell, The Houston Corporation; and Robert P. Jones, Standard Oil of California.

Sun Pipe Line Company announces the election of **James T. Butterfield** to the board of directors and **Louis M. Miller** as assistant secretary.

Butterfield, general superintendent of the crude lines department, has been with the company since 1934. Miller, who joined Sun in 1924, presently is treasurer. **Charles F. Heidrick** is retiring from the board.

Norman F. Tietze has been named general superintendent of products pipe lines in the Supply & Transportation Operations department of **Standard Oil Company of Indiana.** He succeeds **Oscar A. Abbey,** who retires after 38 years of service.

Replacing Tietze as division manager, Twin Cities pipe line division, will be **H. W. Wilker; C. G. Weibel** will succeed Wilker as division superintendent, pipe lines.

Tietze has been with Standard since 1948. He has been Twin Cities division manager at Minneapolis, Minn., since 1955.

O. W. Clark, Southern Natural Gas Co., was elected president of the **Southern Gas Association** at its annual convention in New Orleans, April 27-29.

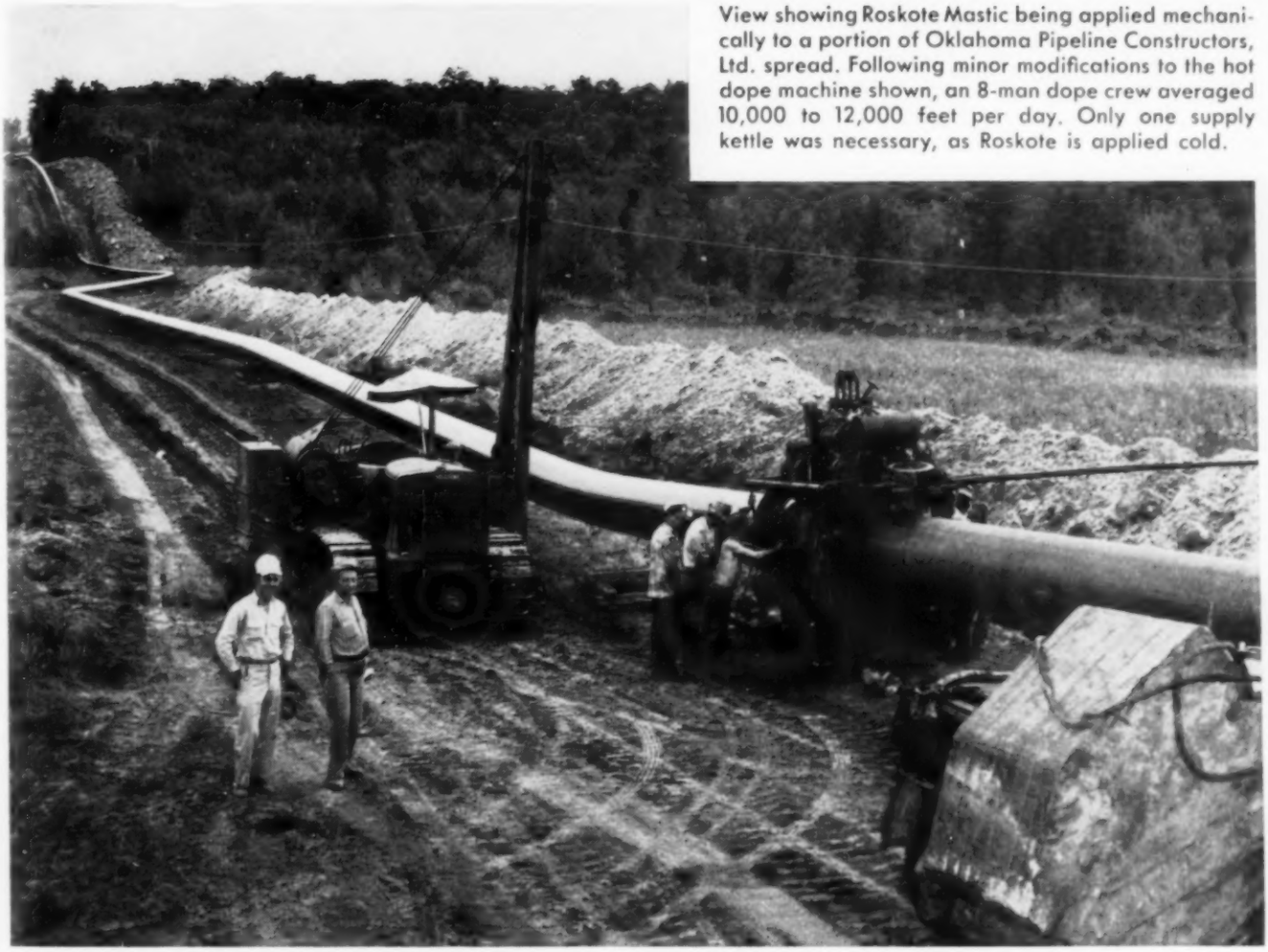
Other officers named were **James A. Wilson,** United Gas Corp., first vice president: **H. A. Eddins, Oklahoma Natural Gas Co.,** second vice president; **Willard G. Wiegel,** Lone Star Gas Co., treasurer, and **Frank Barragan, Jr.,** South Atlantic Gas Co., secretary.

Bechtel Corporation announces the appointment of **W. L. "Stretch" Kennedy, Jr.,** as chief construction engineer of the pipe line division construction group.

His responsibilities also include assistance in business development and contract negotiations. Kennedy has been with Bechtel since 1956 as supervising engineer in the pipe line division. In 1957 he became assistant to **E. J. Mahoney, Jr.,** vice president.

Henry H. Beeson has been appointed manager of **Magnolia Petroleum Company's** gas department. He will assume managerial control of Magnolia's natural gas operations in Texas, Louisiana, New Mexico, Arkansas, Oklahoma and Kansas. He had been assistant manager of the department since 1946.

Beeson joined Sabine Valley Gasoline Company at Shreveport, La. in 1934 and when Magnolia purchased Sabine's properties in 1946 he became assistant manager.



View showing Roskote Mastic being applied mechanically to a portion of Oklahoma Pipeline Constructors, Ltd. spread. Following minor modifications to the hot dope machine shown, an 8-man dope crew averaged 10,000 to 12,000 feet per day. Only one supply kettle was necessary, as Roskote is applied cold.

Roskote Applied Cold with Line Travel Equipment on Trans-Canada 30 Inch

Over rough terrain, with a right of way that crossed solid granite, muskeg, swamp and glacial till, and working under adverse weather conditions, the world's longest and most difficult pipeline construction — Trans-Canada Pipe Lines, Ltd. — has been completed.

One contributing factor in the success of this construction was the adaptation of standard line travel dope machines for the easy application of Roskote cold mastic. This combination of Roskote Mastic and modified line travel machines made possible the coating of ten to twelve thousand feet per day of 30-inch piping on the downstream side of the compressor stations.

Contractors* were able to carry on the coating operation with an 8-man dope crew, using only one supply kettle, requiring no heating fuel and thereby eliminating toxic fumes and fire hazard.

*Contractors on Trans-Canada who applied Roskote by line travel equipment:
Morrison-Shivers, Ltd., Majestic Contractors, Ltd., B. C. Rivers Construction, Ltd., Dutton-Williams Brothers, Ltd. and Oklahoma Pipeline Constructors, Ltd.

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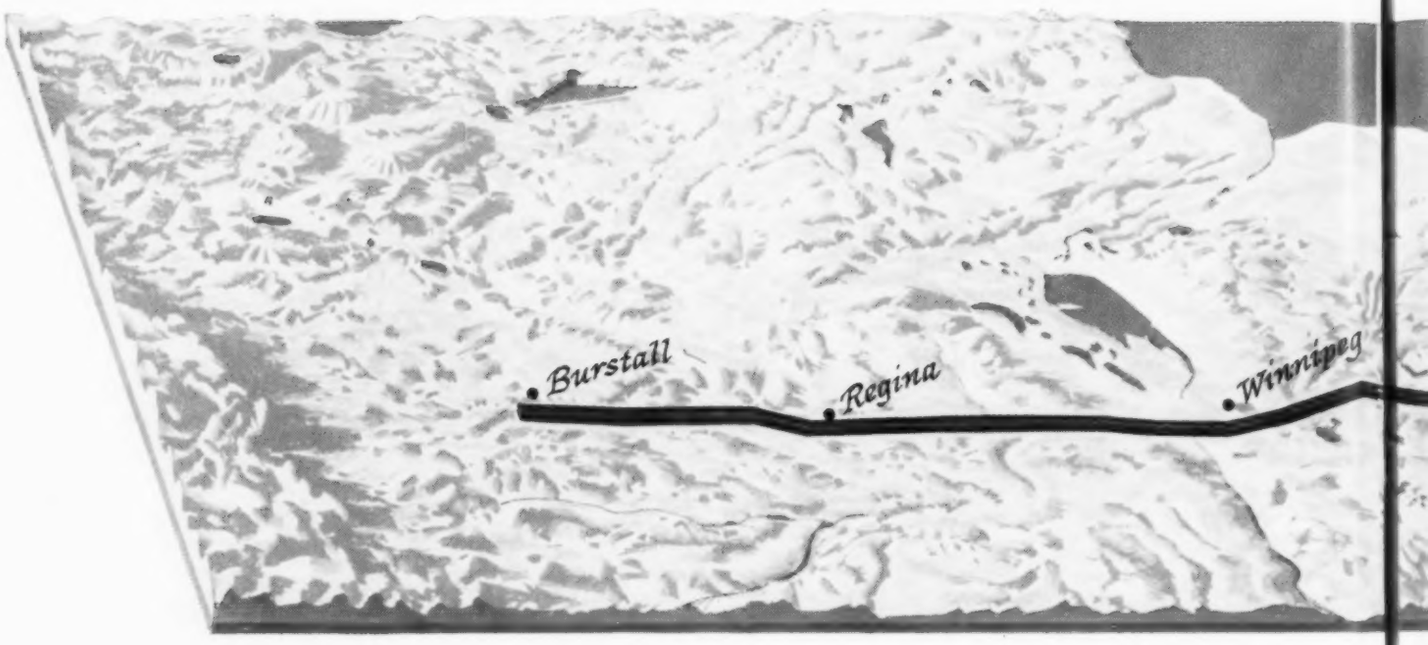

Trans-Canada Pipe Lines completed ahead of schedule despite shifting sands, diamond-hard rock, white water and tricky muskeg

This immense project began in 1954 when 76 miles of 20-inch pipe was laid from Niagara to Toronto. Since then — construction has proceeded ahead of schedule and within estimated costs. Today, Alberta natural gas, rather than gas from American sources, can be delivered at rates of 620 million cu. ft. a day through the main 30- and 34-in. line.

The line spans turbulent rivers, the Great Sand Hills, hard rock and spongy muskeg. Frequently, the work progressed despite temperatures to 48° below zero.

A. O. Smith was one of the major suppliers of pipe for this 2290-mile line which is now delivering natural gas to homes and industries along its route — an area containing three-fifths of Canada's population.

For over 30 years . . .

A. O. Smith line pipe has always been manufactured to a high standard of quality . . . precisely controlled at every step of production. That's why A. O. Smith pipe, made and installed in 1928, is still in operation. That's why so much A. O. Smith pipe is in nearly every important high-pressure line.

90 → miles!

Spanning 2290 miles, the Trans-Canada line reaches from the Province of Alberta to Montreal . . . and proposed additions will extend the line as far east as Quebec.

Typical of nature's efforts to thwart completion of the line were temperatures ranging to 48° below zero. Nevertheless, work progressed ahead of schedule and below estimated costs.

The formidable Laurentian Shield was blasted, ripped, drilled and shattered to make way for Canada's longest natural gas pipeline. Going was rough, but the rewards for Canadians were far greater.

Through research A.O. Smith *. . . a better way*

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For more data on advertised products, use Readers' Service Cards, last page.

If you need a brush cutter like this– we've both been missing a bet!

We're a little ashamed to admit we've never tried to sell the pipe line industry these cutters. You see, Servis Equipment Company *originated* the tractor powered brush cutter. And as the picture indicates, ten years later we're still producing the most rugged cutters made.

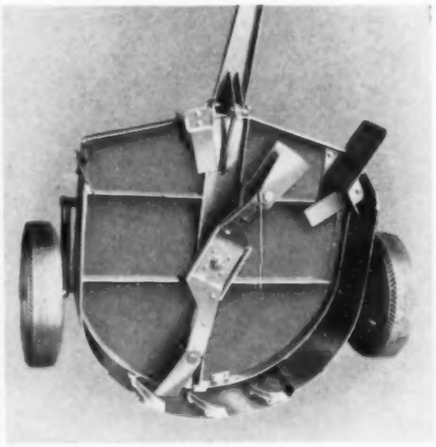
Sticking too close to the farm has been our trouble. Of course, we *have* sold to state highway departments and to the Air Force, but the red tape was so involved that we found it more efficient to concentrate on the farmers . . . even in South America and Africa.

A pipe liner in West Texas bought one of our Gyro 66 Brush Cutters the other day. It cut up tough mesquite brush on his right of way like nothing had before. He was so enthusiastic, he said we ought to tell other pipe liners about it, gave us the name of this publication.

It's true, Servis cutters will take on the toughest job — we've demonstrated them on a row of 4″ x 4″ posts. The secret is in low tip speed, but extra heavy blade assembly for tremendous momentum.

We have dealers from Carlsbad to Caracas. There's one near you. Clip the coupon and send for his name.

Underside shot shows heavy construction, A-shaped blade carrier, optional extra blades for fine shredding.



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- ☐ Gyro 60″ Shredder (Pull & lift models)
- ☐ E 60″ Clipper (Pull & lift models)
- ☐ BM 60″ Mower (Belly mount)
- ☐ Pasture Renovator
- ☐ Whirlwind Terracer
- ☐ Hudson Automatic Row Marker
- ☐ Dump-type Rake
- ☐ Soil Scraper
- ☐ Lone Star Blade (light, 6′)
- ☐ 3-Way Ditcher-Terracer Blade, 6′
- ☐ Heavy Duty 3-Way Blade, 7′
- ☐ No. 7 Angledozer (w/Brush Rake at'chmt) (Row crop tractors)

"Make Pay Dirt Pay More — Join Your Soil Conservation District"

W. B. Haas

A. L. Vaughan

Northern Natural Gas Company announce the election of three vice presidents. **A. L. Vaughan** becomes vice president in charge of operations, southern region; **W. B. Haas** is vice president in charge of operations, northern region; and **J. O. Grantham** is vice president, employe relations.

J. O. Grantham

Vaughan and Haas were general managers in their respective regions prior to their new appointments. Grantham now has charge of administration of the company's personnel policies, employe welfare programs and employe development activities.

E. Clyde McGraw, president of **Transcontinental Gas Pipe Line Corporation**, has been elected second vice president of the Petroleum Club of Houston.

Howard Warren of **Ginther, Warren & Company**, was named president. Other officers include **Walter Sterling**, independent oil operator, first vice president; **Raybourne Thompson** of **Vinson, Elkins, Weems & Searls** law firm, secretary; **H. F. Beardmore**, **Gulf Oil Corporation**, treasurer; and **F. W. Bell, Brown & Root, Inc.**, assistant secretary-treasurer.

Newly elected board of directors consists of Bell, **Joe T. Dickerson**, president of **Shell Pipe Line Corporation**; Thompson; and **W. J. Gillingham, Schlumberger Well Surveying Corporation**, president.

Charles E. Spahr, president of the **Standard Oil Company of Ohio**, has been named to the membership on the board of trustees of Case Institute of Technology.

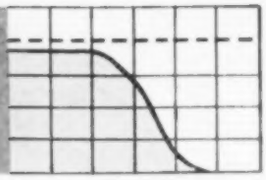
Spahr joined Standard in 1939, was elected a vice president in 1955 and in 1957 was elected president. He supervised construction of one of two major pipe lines in the India-Burma Theatre of Operations.

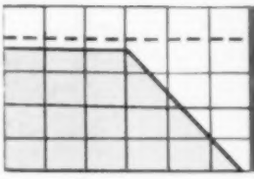
The **Arabian American Oil Company** announces the retirement of **Fred A. Davies**, chairman of the board of directors. Davies, who had been active in Middle East petroleum development for nearly three decades, became chairman of the board in 1952. He had been chief executive officer until 1958. Davies also was a director of the **Trans Arabian Pipe Line Company.**

Kenneth V. Zwiener, president of Harris Trust and Savings Bank, and **Gilbert H. Scribner, Jr.**, partner in Scribner & Co., were elected to the board of directors of **Peoples Gas Light and Coke Company.**

Zwiener and Scribner succeed **Gen. Charles C. Haffner, Jr.**, and the late **James S. Knowlson.**

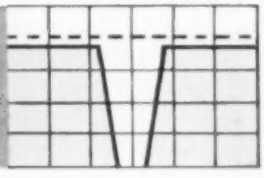
NO DROOP





DROP

OR BREAK



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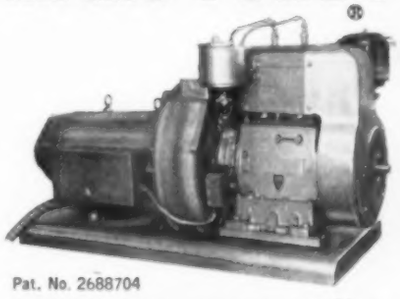

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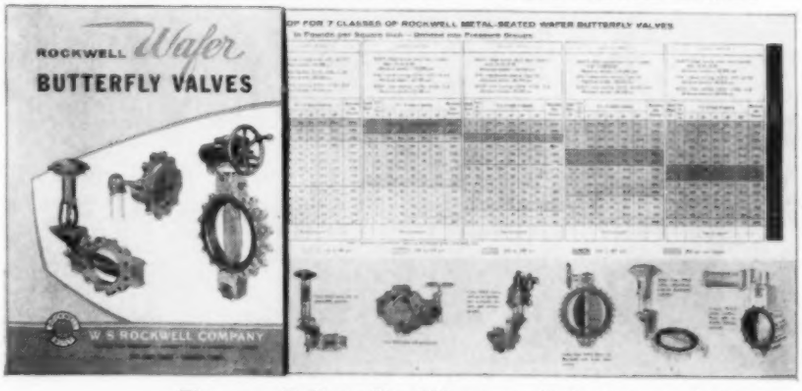

This new Bulletin No. 583 gives all the facts to help you select just the size and construction of valve for your air, gas or liquid lines. Illustrations—charts—tables are arranged in a practical, easy-to-use manner. Write for your copy.

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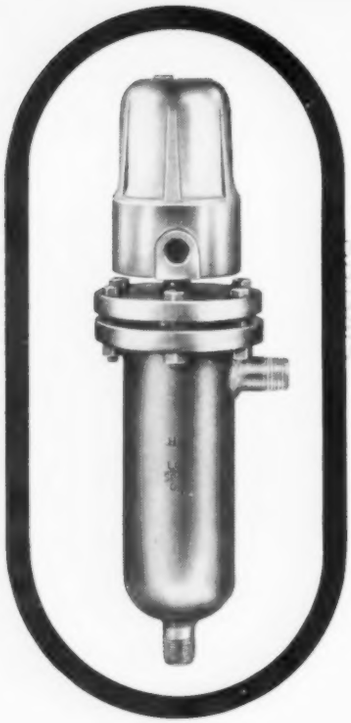

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5456 W. 111th St., Oak Lawn, Ill.
Send full information on Level Master and name of nearest representative.

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Company_____
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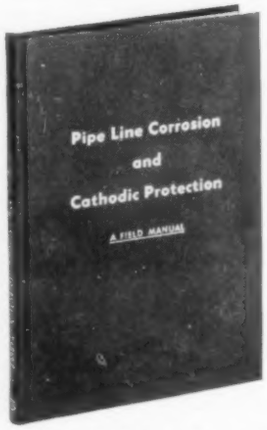

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Pipe Line Corrosion and Cathodic Protection

By MARSHALL E. PARKER

This book is designed as a practical field manual. It provides workable methods that can save you valuable time and effort in obtaining interpretive field data.

Contents (Condensed). Soil Resistivity Surveys, Pipe-to-Soil Potentials, Line Currents, Current Requirement Surveys, Rectifier System for Coated Lines, Ground Bed Design and Installation, Magnesium Anodes on Coated Lines, Hot Spot Detection, Stray Current Electrolysis, Interference in Cathodic Protection, Operation and Maintenance, Coating Inspection and Testing.

Appendices cover: Fundamentals of Underground Corrosion, Basic Principles of Cathodic Protection. Plus . . . tables and properties of metals, attenuation equations and index.

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Texas Gas Transmission Corporation announces the appointment of **Robert N. Curry** as assistant superintendent of gas measurement. Curry will assist superintendent **C. W. Brown** in the over-all direction of gas measurement throughout the pipe line system.

Robert N. Curry

Curry has been with Texas Gas since 1949. He has had experience as a pipe line dispatcher, meterman, district measurement supervisor, division superintendent and supervisor of measurement office.

Eskil I. Bjork, chairman of **Peoples Gas Light and Coke Company**, and **Joseph J. Hedrick**, vice chairman of the board, have been named co-chairmen of the 41st annual AGA convention October 5-7 in Chicago.

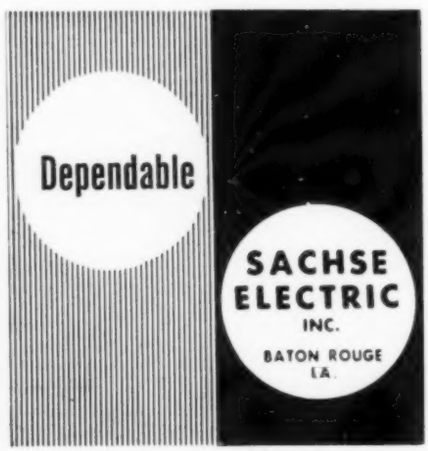
S. C. Sandusky has been appointed supervisor of the engineering and contracts department of the natural gas division for **Ohio Oil Company.** He formerly was petroleum engineer and supervisor of reservoir engineering in the production division.

M. J. Lasseigne has been appointed a vice president of the **Arkansas Pipeline Corporation** and **Arkansas Fuel Oil Corporation.** He will continue his present duties as treasurer and will assume the responsibility for industrial and public relations.

M. J. Lasseigne

Lasseigne began his career with the **Cities Service** organization in 1919 and became head of the tax department in 1932. In 1945 he was elected treasurer of the **Arkansas Natural Gas Corporation** and **Arkansas Louisiana Gas Company.**

Roger N. Stark has been named eastern sales manager for **Tennessee Gas Pipeline Company** with headquarters in Washington, D. C. He has been with the company since 1950 and a member of the sales department since 1955.



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Chairman of the Board
GARY MORRISON
President

For more data on advertised products, use Readers' Service Cards, last page.

Charles E. Webber, technical advisor to the vice president, **Sun Oil Company**, was elected president of the **Natural Gasoline Association of America** at its annual convention in Dallas.

Vice presidents elected include **Donald B. Edwards**, sales superintendent, **Pan American Petroleum Corporation**; **John M. Kindle**, vice president of **Lone Star Gas Company**; **Max R. Lents**, vice president of the **Reef Corporation**; and **R. W. Heath**, vice president of **Signal Oil & Gas Company**.

Webber has been with Sun Oil since 1945; in 1951 he became director of the natural gas production and processing division of the Petroleum Administration for Defense. In 1952 he returned to Sun as technical advisor to vice president.

William F. Lowe, executive director of the **Natural Gasoline Association of America**, was awarded the Hanlon Award, highest honor in the natural gasoline industry. Lowe became secretary of the NGAA in 1934 and was named executive director in 1957.

John W. Hawkins, manager of planning and development for **Mid-Continent Pipe Line Co.**, was elected president of the Tulsa chapter of the American Institute of Industrial Engineers.

Other officers include **Don Matthews**, vice president; **John Roche**, secretary; and **Fred Kadave**, treasurer.

Saskatchewan Power Corporation announces several changes in management levels of the company. The management advisory committee now consists of the assistant general manager, in charge of engineering, **W. B. Clipshap**; assistant general manager in charge of operations, **R. R. Keith**; director of public and employe relations, **C. E. Smith**; and the comptroller in charge of financial operations, **D. E. Cuddington**.

Promotion of seven employees in the Texas area has been announced by **Natural Gas Pipeline Company of America, Texas Illinois Natural Gas Pipeline Company**, and **Texoma Production Company**, affiliates.

In the Amarillo area, **J. W. Hancock** was appointed general superintendent of exploration; **L. L. Farmer**, general superintendent of gas contracts; **W. B. Verner**, gas supply engineer; and **S. E. Spurgeon**, superintendent of drilling.

NGPL and TI station personnel changes include **D. R. Wendele**, assistant superintendent at Fritch, to superintendent at Stinnett, replacing Verner; **R. L. Pivonka**, Wharton station superintendent to assistant superintendent at Fritch; and **R. G. Shaddox**, special engineer, to Wharton station superintendent.

Phillips Petroleum Company announces the election of six vice presidents. Formerly managers of their departments, the vice presidents are **Harry G. Fair**, supply and transportation; **R. B. Stewart**, natural gas; **G. W. McCullough**, natural gasoline; **L. E. Fitzjarrald**, production; **E. H. Lyons**, sales; and **C. C. Tate**, refining.

Fred M. Odom, Jr., vice president of **United Gas Pipe Line Company**, and **C. A. Sullins** have been named to the board of directors of **Union Producing Company**.

Odom has been vice president of United Gas Corporation, United Gas Pipe Line Company, and Union Producing Company since 1957. Sullins joined Union Producing Company in 1937.

Service Pipe Line Company has moved its district headquarters from Alvin, Texas to South Houston. The Houston district also includes pipe line facilities at Willamar and Port Isabel.

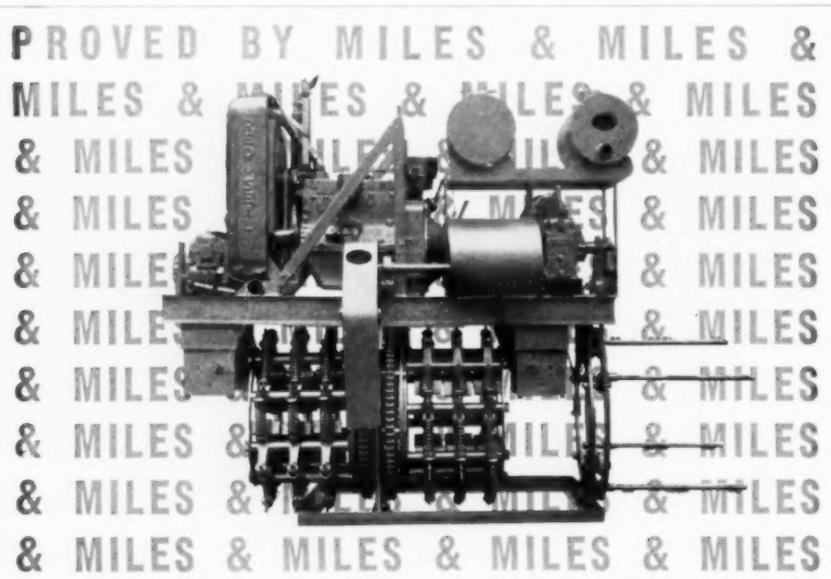
W. W. Cofield has been named to the newly created position of assistant superintendent of the measurement department of **Transcontinental Gas Pipe Line Corporation**.

Cofield previously was senior engineer in the Pipe Line department.

Ford, Bacon & Davis, Inc., has moved to new headquarters in New York at 2 Broadway. The engineering firm also has offices in Chicago, Los Angeles and Monroe, La.

J. W. Emison, president of **Texas Pipe Line Company**, has been elected president of the Texaco Old Timers Club of Houston. Emison has been with the Texaco organization for 30 years and succeeds **L. T. Tighe**, division manager of Texaco's Houston Division producing department.

Other officers include vice presidents **R. E. Greenwell**, credit manager of Houston Division sales department; **W. F. Herbert**, assistant to the division manager of the Houston Division producing depart-


PROVED BY MILES & MILES &
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of Cleaning and Priming on Pipelines all Over the World . . .

- **Line-Traveling or Stationary Yard and Railhead Types**
- **Counter-Rotating Heads to Eliminate Torque Strain on Cradles**

Perrault cleaning and Priming machines are available for pipe sizes from 2" through 36". Model ER features counter-rotating heads for cleaning large diameter pipe with any combination of cutters, knives and brushes from both directions at once. Years of experience in serving the pipeline industry have proved Perrault cleaning and priming machines. Let us prove them to you with a demonstration. Just call LUther 5-1103 in Tulsa.

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Line Traveling and Stationary Coating and Wrapping Machines, Cleaning and Priming Machines, Pneumatic Clamps. Perrault-American Tar-Heating Kettles, Patchpots, Burners, parts and accessories. Esco Digging Teeth Pipe Protection Materials — Kraft, Asbestos Felt, Glass Wrap and Rock Shield. General Supplies—Hooks, Blocks, Line-Up Clamps, Sling Belts, Cradles, Hand Tools, materials, supplies and equipment of every sort . . . Everything for the Pipeliner.

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Many new techniques and methods of telemetering are available today as a result of rapid advances in the science of data processing and transmission. Today, more than ever, selection of the telemetering system best suited to a particular application requires careful study of many alternatives to insure maximum effectiveness at minimum cost.

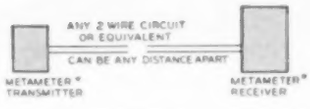
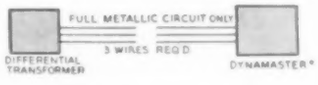
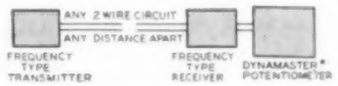
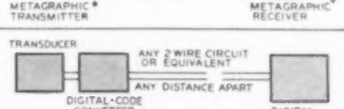
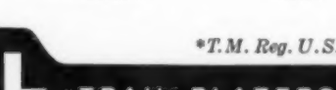
The Bristol Company offers *all* the major types of industrial telemetering systems, as outlined in the table herewith. For some applications, of course, certain features of one system may be combined with another, allowing great flexibility in tailoring a system to your application.

The complete line of Bristol industrial telemetering instruments embodies over 45 years' experience in this field. Bristol engineers are always ready to recommend telemetering instruments to solve your particular problems or to work closely with your own engineers in the design of a complete telemetering system to your requirements.

For further information, write: The Bristol Company, 114 Bristol Road, Waterbury 20, Connecticut. 9.6

TIPS ON INDUSTRIAL TELEMETERING

for pipe lines, utilities, and process industries

TYPE	OFFERED BY BRISTOL	SIMPLIFIED BLOCK DIAGRAM	ADVANTAGES AND LIMITATIONS	MAJOR USES
IMPULSE DURATION	Metameter*		Simple electro-mechanical device. Will transmit over wire circuit, carrier or microwave links. Offered in 60, 15, 5 or 2 second impulse cycles.	For analog transmission of all measurands.
VOLTAGE	Thermoverters* & Dynamaster.* D-C Transmission		Instantaneous transmission. Limited to full metallic circuits of 2000 ohms (2 wires) free of parisitic currents.	For analog transmission of electrical quantities.
	Differential Transformer Transmitter & Dynamaster. A-C Transmission		Instantaneous transmission. Limited to full metallic circuits. (3 wire.) Can operate into electronic control directly.	For analog transmission of mechanical measurands.
FREQUENCY	Frequency Type Transmitter & Receiver with or without Audio Tone. (RFL) Model with Dynamaster End Device		Practically continuous. For millivolt inputs or measurand to millivolt pick-ups. Will operate over wire circuits, carrier or microwave radio links.	Primarily for transmission of electrical measurands but may be adapted to non-electrical quantities where high speed transmission desired.
PULSE COUNT	Transmitter — Contact Making Device. Receiver — Relay Operated Magnetic Counter or Running Count Recorder		Simple. Will transmit over wire circuit, carrier or microwave link.	Primarily for total flow transmission. Not used for instantaneous flow.
POSITION	Dynamaster Resistance Thermometer System		Instantaneous Transmission. Requires 3 wire metallic circuit not exceeding 1500 feet.	Temperature measurements.
PNEUMATIC	Metagraphic System. Metavane* System		Limited to 1000 feet of ⅛" tubing. Can operate into pneumatic control directly.	For non-electrical quantities where pneumatic transmission desired.
DIGITAL	Bristol Servo Transducer with Westinghouse, G. E., or Union Switch & Signal Pulse Code System		For transmission over wire circuits, carrier or microwave.	For digital transmission of all measurands, especially where pulse code supervisory control is available. Direct print-out of readings.

T.M. Reg. U.S. Pat. Off. **Write for technical information**

BRISTOL TRAIL-BLAZERS IN PROCESS AUTOMATION

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

ment: **E. M. Jacobs**, comptroller department; **Miss Jane Earle Bruce**, comptroller department, secretary; and treasurer, **P. H. Dixon**, tax division.

R. W. Miller

Northern Natural Gas Company has announced plans to open a gas supply office in Billings, Montana with **Raymond W. Miller** as manager. The office will investigate prospective natural gas sources in North Dakota, Montana and Wyoming.

Miller, formerly with the U.S. Bureau of Mines Helium Activity at Amarillo, Texas, has over 20 years experience in the petroleum industry.

WHO'S MEETING WHERE

June

Technical Writer's Institute, Rensselaer Polytechnic Institute, Troy, N. Y., June 8-12.

ISA, second international symposium on gas chromatography, East Lansing, Mich., June 10-12.

ASME, semi-annual meeting, Chase-Park Plaza Hotel, St. Louis, June 14-18.

Society of Automotive Engineers, summer meeting, Chalfonte-Haddon Hotel, Atlantic City, June 14-19.

Institute of Gas Technology, Illinois Institute of Technology, natural gas transmission session, Chicago, June 15-July 3.

ASME, applied mechanics conference, Virginia Polytechnic Institute, Blacksburg, Va., June 18-20.

American Society for Testing Engineers, annual meeting, Chalfonte-Haddon Hall, Atlantic City, June 21-26.

Michigan Gas Association, meeting, Grand Hotel, Mackinac Island, June 22-23.

Canadian Gas Association, annual meeting, Empress Hotel, Victoria, B. C., June 22-24.

July

University of Michigan, short course on underground storage of natural gas, Ann Arbor, Mich., July 6-15.

University of Michigan, research conference on underground storage of natural gas, Ann Arbor, Mich., July 16-17.

August

Society of Automotive Engineers, national west coast meeting, Hotel Georgia, Vancouver, B. C., August 10-13.

AIEE, annual petroleum industry conference, Wilton Hotel, Long Beach, Calif., August 23-26.

September

NGAA, Rocky Mountain Regional meeting, Casper or Calgary, Alberta, Canada, September 17.

ASME, petroleum mechanical engineering conference, Rice Hotel, Houston, September 20-23.

ISA, 14th annual instrument-automation conference and exhibit, International Amphitheatre, Chicago, Sept. 21-25.

NACE, western region conference, Bakersfield Inn, Bakersfield, Calif., Sept. 29-30.

October

NACE, southeast region, Jacksonville, Fla., Oct. 1-2.

NACE, northeast region, Lord Baltimore Hotel, Baltimore, Md., Oct. 5-7.

AGA, 41st annual convention, Conrad Hilton Hotel, Chicago, Oct. 5-7.

NACE, south central region, Cosmopolitan Hotel, Denver, Oct. 12-15.

ASCE, pipe line division, annual meeting, Washington, D. C., Oct. 19-23.

NACE, north central region, Cleveland, Oct. 20-22.

ASME, ASLE, lubrication conference, Hotel Sheraton-McAlpin, New York City, October 20-22.

November

API, 39th annual meeting, Conrad Hilton, Palmer House and Congress Hotels, Chicago, Nov. 9-11.

Fifth International Automation Exposition, New York Trade Show Building, New York, November 16-20.

Another **BORTUNCO** *Success Story:*

BorTunCo has an established record with engineers and contractors for capable sub-contract job performance.*

179,115 feet of bores and tunnels—ranging in size up to 12 feet in diameter—were completed in 1958 by **The Bortunco Group.**

Work was completed in **23 states** for **511** satisfied customers!

The Bortunco Group is the answer to your boring and tunneling problems.

Call our nearest office for a quote on your next job.

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What's Happening

among SERVICE and SUPPLY MEN

PESA Elects New Officers

The Petroleum Electrical Suppliers Association elected new officers for 1959-60 at its recent convention in Galveston. New officers are, seated, left to right, Theil W. Sharpe, Collins Radio Company, president; John D. Trilsch, John D. Trilsch Incorporated, vice president; and P. S. King, Westinghouse Electric Corporation, executive secretary-treasurer. The directors include, standing, left to right, Douglas F. Ball, Motorola C & C Incorporated, chairman of the board; C. A. Gunn, Kellogg Switchboard & Supply Company; E. E. Tuel, Railway communications; Pat Wilson, Southwestern Bell Telephone Company and (not pictured) H. C. Shelton, S & S Radio Supply; and Jack R. Jacobs, Nelson Electric Manufacturing Company.

Atlas Powder Company Selects Three District Sales Managers

Atlas Powder Company's Explosives Division has appointed three district sales managers. Stephen M. Wilson, Jr., formerly manager of Joplin, Mo., becomes head of the eastern district with headquarters in Wilmington, Del. M. A. McDuff, sales supervisor, Houston, is now manager of the Joplin district. Walter R. Law, special representative in the Chicago area, has been named manager of the Pittsburgh, Penn., district.

Wilson joined Atlas in 1937. McDuff has been with the company since 1947 and Law has been in the organization since 1949.

Gale Carroll Forms Tube Process Corporation

Gale Carroll, developer of a new plastic pipe lining for internal coating, has formed the Tube Process Corporation. The new plant, located at 6900 Old Katy Road, Houston, consists of 11,000 square feet; the highly automatic process handles pipe with pneumatic and electric controls.

Grove Valve and Regulator Co. Announces Personnel Transfers

Ted Roby Jr. has been transferred from Odessa to Dallas and Walter O. Edrington from Chicago to Pittsburgh, in personnel changes for Grove Valve and Regulator Company.

Youngstown Sheet and Tube Appoints Doolittle Secretary

Robert F. Doolittle has been named general counsel and secretary of the Youngstown Sheet and Tube Company. William J. Harnisch has been appointed assistant secretary. Doolittle succeeds James E. Bennett. He has been with the company since 1952; previously he had been vice president of Baldwin-Lima-Hamilton law firm.

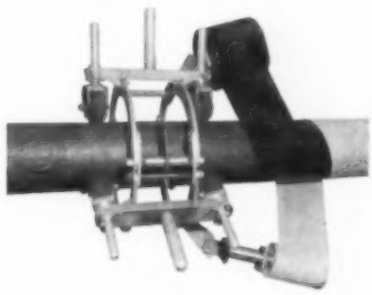
Johns-Manville Appoints Geiger New Sales Manager

Johns-Manville Dutch Brand Division announces the appointment of C. Gregg Geiger as general sales manager. Geiger began his career with Johns-Manville in 1947 as a market analyst in the Dutch Brand Division in Chicago and was named merchandise manager in 1950.

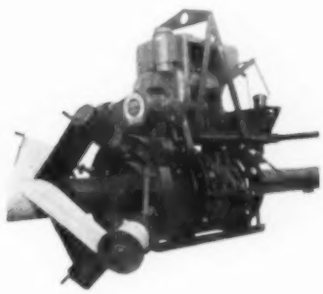
MYOCO...

For More Dependable Equipment and Service

HERE ARE MACHINES THAT BRING ADDED EFFICIENCY TO YOUR TAPING AND CLEANING AND TAPING.



The MYOCO Tapemaster can use four arms to give any combination of tape and kraft or felt. Six various size machines available for ½" through 36" pipe; small machines use tape from ½" width through 9", large machines use 9" through 18" tape.



MYOCO Model OW Power Driven Cleaning and Taping machine combines two operations for increased speed of operations with less equipment. Line travel machines are available to handle pipe sizes 3" to 6", 6" to 12", and 14" to 20". A Wisconsin Model Vg4D V-type 4-cylinder heavy-duty air cooled engine, combined with the design and engineering features of this machine, guarantees uninterrupted service.

When you use MYOCO pipeline equipment, you quickly find that servicemen are experienced and available twenty-four hours a day, with fast transportation available to serve you in any way; efficient equipment operation is assured by periodical checks; and if possible, parts and supplies are shipped the same day ordered.

MORRIS-YOUNG-OWENS CO. PIPELINE EQUIPMENT AND SUPPLIES MYOCO

MORRIS-YOUNG-OWENS CO.

PIPELINE EQUIPMENT AND SUPPLIES

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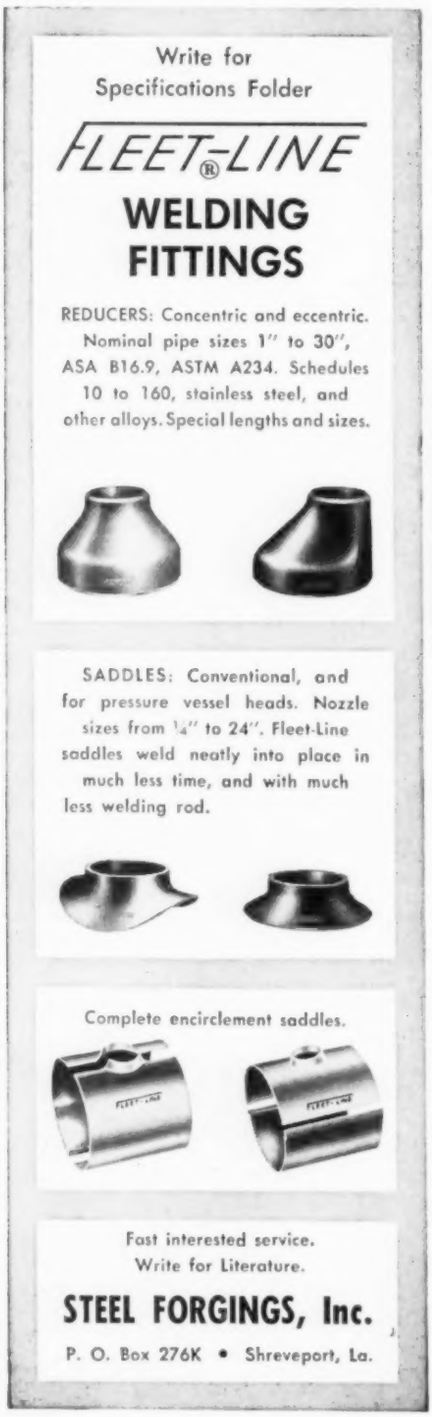
PArkview 3-0110

In Canada: MYOCO LTD., 30 Bloor St. West Toronto 5, Ontario, Canada, Tel. WA 2-9444

For more data on advertised products, use Readers' Service Cards, last page.


Write for Specifications Folder
FLEET-LINE
WELDING FITTINGS
REDUCERS: Concentric and eccentric. Nominal pipe sizes 1" to 30", ASA B16.9, ASTM A234. Schedules 10 to 160, stainless steel, and other alloys. Special lengths and sizes.
SADDLES: Conventional, and for pressure vessel heads. Nozzle sizes from ¼" to 24". Fleet-Line saddles weld neatly into place in much less time, and with much less welding rod.
Complete encirclement saddles.
Fast interested service.
Write for Literature.
STEEL FORGINGS, Inc.
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Three Million Engines

The 3,000,000th air-cooled engine produced by Wisconsin Motor Corporation is helped off production line by (left to right) President H. A. Todd; A. J. Brown, vice president; George Zunker, president UAW Local 283; Clarence Bohman, general superintendent; and R. J. Fellows, vice president and sales manager. The 3 million engines represent 35,788,280 hp—more than eight times the combined electrical capacities of Grande Coulee and Hoover dams.

Allen Named Director For Bucyrus-Erie Co.

R. G. Allen

Robert G. Allen has been elected to the board of directors and executive committee of Bucyrus-Erie Company. Allen is executive vice president of the company in charge of all manufacturing and sales.

Before joining the firm in 1957, Allen had been president of the Pesco Products and Wooster divisions of the Borg-Warner Corporation. He started his career with Walworth Co. He was later president of the Duff-Norton Mfg. Co.

William I. Pell Appointed Sales Manager for Kerotest

William I. Pell has joined Kerotest Manufacturing Company as sales manager, Steel Products division. Pell formerly was manager of pipe sales for the Colorado Fuel and Iron Corporation. Previously he had been with Worth Steel Company.

Royston Laboratories, Inc., Opens Office in St. Petersburg, Fla.

Royston Laboratories, Inc. announces the opening of a new sales office in St. Petersburg, Fla., and warehouse facilities in Tampa, Fla.

Murray Newell has been appointed new sales representative for Florida, southern Alabama and southern Georgia. Newell has 10 years experience with Shaw-Walker Company.

H. R. Ogburn and Paul Weber Form Manufacturing Company

H. R. Ogburn and Paul Weber, formerly with Grip-Tite Manufacturing Company, have formed a new company, Ogburn-Weber Manufacturing Company. Headquarters will be in Marshall, Texas. The company will manufacture anchors for oil field and pipe line construction use. Also, the new firm will build welding saddles, cast iron river weights and other pipe line special items.

Crose Promotes Royal to Denver Office Manager

W. H. Royal has been named manager of the Denver office for M. J. Crose Manufacturing Company, Inc. He will have jurisdiction over Crose sales-service activities throughout the entire western United States.

Royal joined the Crose sales department in 1958. Previously he had been assistant sales manager for Browning-Ferris Machinery Company.

Mercer Trucking Company Opens New Yard and Terminal

T. E. Mercer Trucking Company announces the completion of its new Houston Yard and Terminal on the San Jacinto River. W. D. Davis continues as terminal manager.

Mercer's Yard was originally located on Phillip's Adam's Terminal in Pasadena, Texas, where 30 acres of storage space will be maintained.

D. L. Douglass

J. L. Beltz

Thew Appoints Douglass Director of Marketing

Thew Shovel Company announces the formation of a Marketing division for the company's Lorain line of power shovels and cranes and moto-loader line of front end loaders.

J. F. Beles

D. L. Douglass becomes director of marketing to head the new division. He has been with Thew as manager of parts division, director of parts and service and assistant to the president. J. L. Beltz has been promoted from director of sales promotion to manager, marketing staff with over-all supervision of the Product Development, Market Research, Advertising, and Sales Promotion and Training departments.

Douglass appointed J. F. Beles manager of parts and service. Beles has been with Thew since 1948 when he became district sales manager.

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All-new 1959 Transistorized

M-SCOPE PIPE FINDER

only **$189.50**

- Greatest depth penetration
- Greatest tracing distance
- Pinpoint accuracy
- One year between battery changes
- Built-in battery testers
- 90% less maintenance costs

New, Transistorized
LEAK DETECTOR

- Finds leaks faster, more accurately
- Weighs 80% LESS than ordinary equipment

only **$295.00**

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CATHODIC PROTECTION
Good-All
RECTIFIERS

By far.....the finest!

Rugged, efficient, competitively priced. Years of dependable protection have earned Good-All rectifiers their reputation as the finest money can buy!

See your Good-All representative for complete information.

GOOD-ALL ELECTRIC MFG. CO.
OGALLALA, NEBRASKA

Charles A. Rawson Announces New Firm Name—Southwestern Pipe, Inc.

Southern Sales & Transportation Company has now become Southwestern Pipe, Inc., according to an announcement by Charles A. Rawson, vice president.

C. A. Rawson

Southwestern will continue to operate two line pipe mills, Seismo-Tube shot hole casing and mechanical tubing for a wide variety of applications. The Company also supplies explosives and allied products. D. C. Wiggins is sales manager of the line pipe division and J. C. Moore is sales manager of the mechanical and structural division.

Atlas Valve Company Appoints Four Sales Representatives

Atlas Valve has announced the appointment of four new sales representatives.

R. L. Crane, Charlotte, N. C. will cover North and South Carolina; Weedon Engineering Company, Jacksonville, will represent Atlas in Florida; W. C. Christianson, Jackson, Miss., will cover Mississippi; and Louisiana will be represented by Morre Instruments, Inc., Houston.

Bristol Company Appoints John Peterson Branch Manager

The Bristol Company announces the appointment of John F. Peterson to branch manager of the Newark, N. J., branch office.

Peterson joined the Bristol Company in 1948 as a service engineer; he was promoted to sales engineer in 1954 and in 1955 he was made sectional sales engineer at Syracuse, N. Y.

Kellogg Switchboard Names McLendon Sales Manager

Holmes D. McLendon has been named sales manager of commercial products for Kellogg Switchboard and Supply Company. He will direct sales of Kellogg's intercommunication systems and equipment. Prior to joining Kellogg, McLendon had been assistant sales manager of the B. J. Electronics Division of Borg-Warner Corporation. Previously he was manager of equipment sales for Farnesworth Electronics.

Freeman Elected Vice President, General Manager for Magnetrol

Magnetrol, Inc., announces the appointment of John J. Freeman as vice president-general manager. Freeman previously had been with International Register Company.

John E. Boyd Appointed Brodie Meters Representative

John E. Boyd has been named a field sales representative for Brodie Meters in the Long Island, New York, territory. Boyd has been with the company for 12 years holding positions in the field service and field engineering in the eastern divisions at Mt. Vernon, New York.

This report helps you save on pump-station maintenance

Here's a new Oakite Service Report – free, of course – on maintenance cleaning at the pipeline pumping station.

It's full of valuable, time-saving ideas ... any one of which might turn out to give you a deep cut in maintenance costs. You'll find helpful shortcuts on:

- Engine room maintenance
- Lube oil cooler maintenance
- Cleaning electric motors, generators, control panels, etc.
- Paint stripping
- Storage tank cleaning
- Cleaning crude and natural gas lines

FREE. Write for a free copy of this Oakite Service Report No. B6878. Address Oakite Products, Inc., 51A Rector Street, New York 6, N.Y.

SPECIALIZED INDUSTRIAL CLEANING
OAKITE.
MATERIALS · METHODS · SERVICE
SCIENCE

In our 50th year

Export Division Cable Address: Oakite

Technical Service Representatives in Principal Cities of U. S. and Canada

For more data on advertised products, use Readers' Service Cards, last page.

PESA Elects Wilson President, Staudt Vice President for 1959-60

Wallace D. Wilson, president of Wilson Supply Company, was elected president of the Petroleum Equipment Suppliers Association at its annual meeting in Boca Raton, Fla.

John G. Staudt, executive vice president and a director of Dowell Incorporated, was named vice president.

Newton D. Baxter Appointed Marketing Vice President

Newton D. Baxter has been elected to the newly created position of marketing vice president for Black, Sivalls & Bryson, Inc. Baxter formerly had been director of employe and public relations and will continue his responsibilities for advertising, sales promotion, and public relations activities. He will participate in the review and analysis of marketing operations in all divisions, and assist division sales managers with training and planning programs.

Rockwell Manufacturing Co. Appoints Two Branch Managers

Micheal P. Groom has been named El Paso branch manager and John R. Applegate has been appointed Detroit branch manager.

Groom joined Rockwell in 1946 as a sales engineer; from 1955 to 1957 he was assistant manager of distribution sales, meter and valve division. He became manager of Detroit office in 1957 and in El Paso will head the meter and valve division. Applegate has been with Rockwell since 1948; he has been sales engineer, sales supervisor and senior sales engineer for all meter and valve products.

F. W. Laverty

J. N. MacKendrick

F. W. Laverty Appointed President of Clark Bros. Co.

F. W. Laverty has been named president of Clark Bros. Co., and J. N. MacKendrick, former president of Clark, was made chairman of the board.

MacKendrick, who has been with Clark since 1928, will continue to headquarter at executive offices in Olean, N. Y. Laverty joined the firm in 1927 as an employe in the foundry.

Smith-Erie Division Formed By A. O. Smith Corporation

A. O. Smith Corporation's Meter and Service Station Pump divisions and Erie Systems, Inc., have been merged and will be known as Smith-Erie Division.

Appointments in the new division include J. S. Thompson, assistant sales manager; J. W. Harris, sales manager, engineered products; C. P. Hammill, sales promotion manager; L. G. Blumenberg, service manager; and R. L. Dull, assistant service manager.

White Truck Division Names Moss Service Sales Manager

Charles W. Moss has been named service sales manager of the White Truck Division of White Motor Company. He succeeds Harold Halderman, who entered White's management sales training course.

Moss has been with the company since 1946 and served as assistant service manager, parts manager, and retail truck salesman.

Pittsburgh Coke & Chemical Names John E. Himmelrich Sales Manager

John E. Himmelrich has been named eastern regional sales manager of Pittsburgh Coke & Chemical Company's protective coating division. He will succeed Howard F. Trusler, Jr., who is now sales manager of the division's regional office at Houston.

Formerly, Himmelrich had been central-west division sales representative in Tulsa. He has been with the company since 1951.

Ross and Binder Promoted By Allis-Chalmers Manufacturing Co.

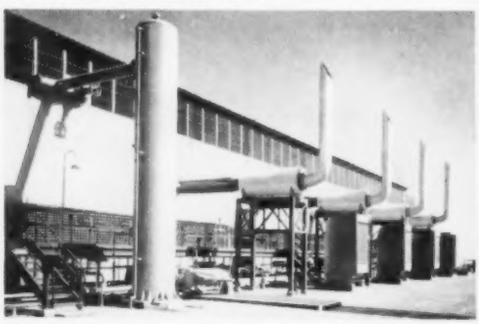
Homer P. Binder has been named a consultant and Hugh L. Ross was made manager, West Allis pump department of General Products Division, for Allis-Chalmers Manufacturing Co.

Binder has been with the company since 1911 and has been manager of the department since 1942. Ross, who joined Allis-Chalmers in 1928, has been assistant manager of the centrifugal pump department since 1955.

Theodore E. Veltfort, Jr. Joins Lynch Carrier Systems, Inc

Theodore E. Veltfort, Jr., has joined the Lynch & Carrier Systems, Inc., engineering staff. In his capacity of design engineer, Veltfort will be concerned primarily with equipment involving pulse techniques.

COMPRESSORS AND



GENERATORS ARE

MAXIM-QUIET

The new Needles, California Compressor Station operates with quiet efficiency. Maxim Silencers cut down exhaust noise and intake pulsation to the minimum. Specify the world's most widely used silencer—a Maxim. There's no quiet like *Maxim-Quiet*.

Photos courtesy of Southern California and Southern Counties Gas Companies

Emhart Manufacturing Company
Maxim Division
Box 216, Hartford 1, Conn.

EMHART

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Please send me bulletins on Maxim Silencers for

- ☐ Waste heat recovery
- ☐ Steam, air or gas discharges
- ☐ Jet engine exhaust and intake
- ☐ Internal combustion exhaust and intake
- ☐ Air compressor intakes and discharges
- ☐ Blower intakes and discharges

name

company

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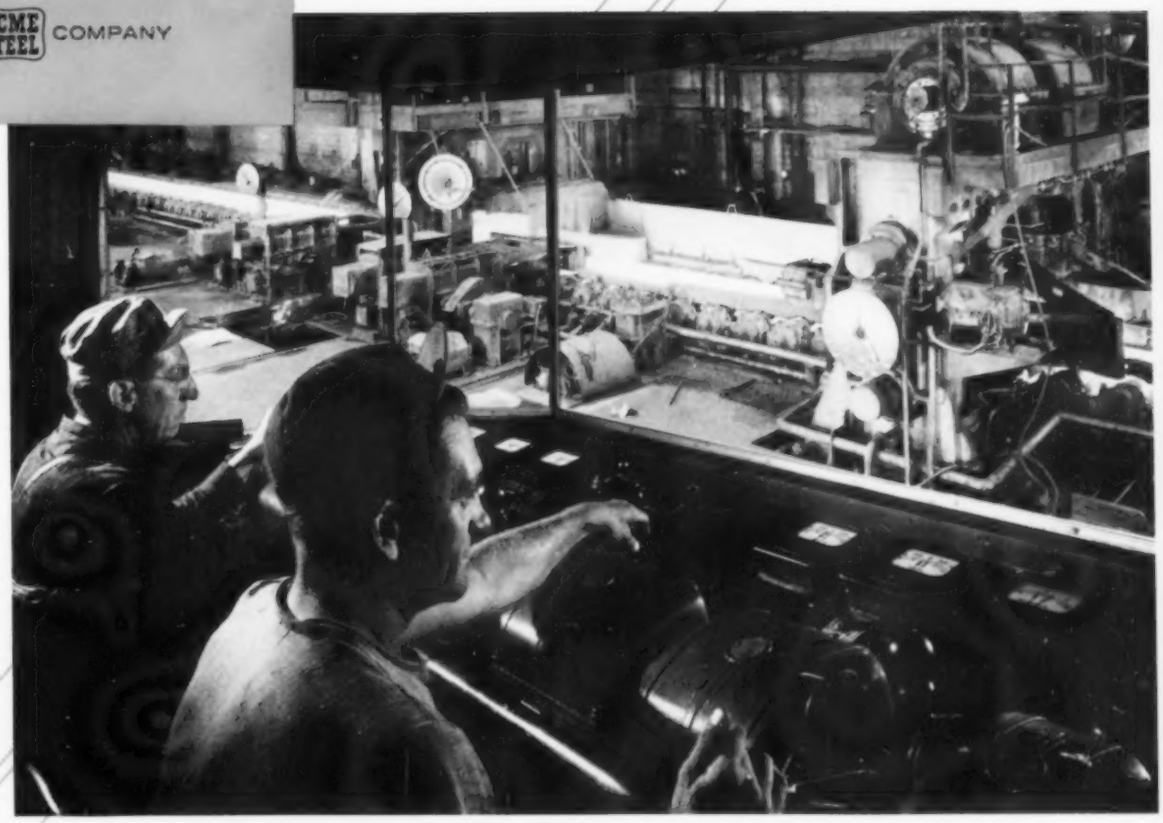
Acme-Newport Steel COMPANY

NEWPORT, KENTUCKY

A SUBSIDIARY OF ACME STEEL COMPANY



PRESCRIPTION

FOR BETTER LINE PIPE*

Experience, Youth, Modern Facilities

At Acme-Newport you have a time-tested formula for unexcelled quality in electric weld line pipe . . . a combination of 75 years' steelmaking background, efficient new facilities, men with long experience and with youthful drive. Over 25% of the personnel have served 25 years or more, while young men continually are being well trained to maintain the quality traditions of this basic steel producer.

The result is consistent pipe performance on which you always can depend. Every length is true round and uniform in wall thickness. It bends readily, welds easily, installs and functions trouble-free. Available in 4" and 6" sizes, standard or thin wall. Ask for complete information.

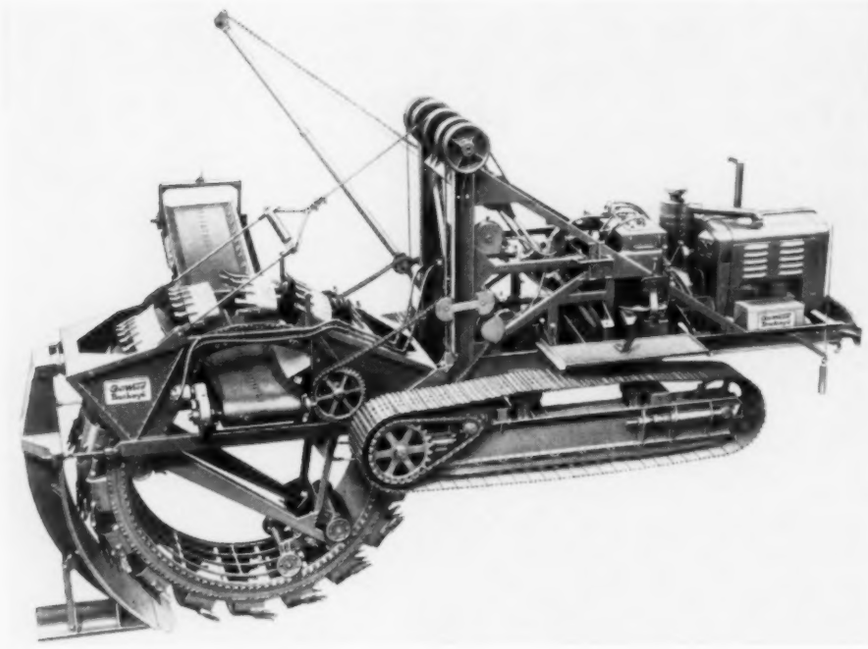
ACME-NEWPORT STEEL COMPANY, NEWPORT, KENTUCKY

***SIZES AND WEIGHTS AVAILABLE**

O.D.	Wall	Wt. Per Ft.
4½	.125"	5.84
	.142"	6.61
	.156"	7.25
	.188"	8.64
	.219"	10.00
	.237"	10.79
6⅝	.156"	10.78
	.188"	12.89
	.219"	14.97
	.250"	17.02
	.280"	18.97

What's New in EQUIPMENT

To receive more information on all new equipment articles use Readers' Service Card, last page of this issue.

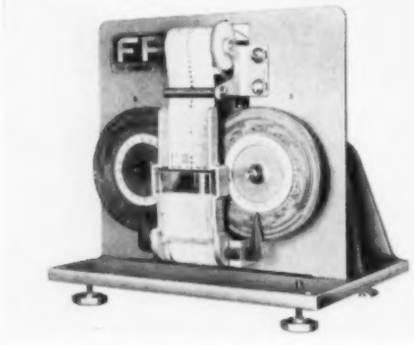


Medium-Duty Ditcher

Featuring a torque converter drive and complete hydraulic action, Gar Wood Industries, Inc.'s medium-duty pipe line ditcher digs up to 7 feet in depth and 44 inches in width.

The Gar Wood-Buckeye 318 is transportable on standard trailers, without special teardown. The torque-o-matic drive works in conjunction with a tailshift governor. As the governor regulates engine torque, the digging wheel maintains a constant speed regardless of changing conditions. Fingertip controls let the operator control the placement of spoil by varying the speed of the spoil conveyor. Two 8-inch hydraulic cylinders operate the ditcher's independent wheel hoist. All hydraulic functions are independent of wheel, traction, and conveyor speeds.

For more data, circle **No. E1** on Readers' Service Card, last page this issue.



Analog-to-Digital Recorder

Fischer & Porter Co. has developed a shaft-input analog-to-digital recorder that records analog values in binary-decimal punched tape form. The tape can be read directly, or translated automatically into standard punched cards or tape for computer processing. The ADR also supplies digital information in the form of electrical contacts that may be used for telemetering.

The ADR may be operated from commercial power supplies or by battery.

For more data, circle **No. E2** on Readers' Service Card, last page this issue.

Hard-Facing Electrode

A high alloy-hard-facing electrode with high resistance to extreme abrasion, medium impact and high compressive loads has been developed by Stoody Company.

The equipment is designed for use on earth-moving equipment such as shovel buckets and teeth, crushers and other parts subject to the destructive wear.

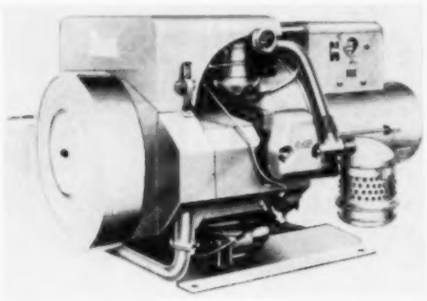
For more data, circle **No. E3** on Readers' Service Card, last page this issue.

Diesel Generating Plant

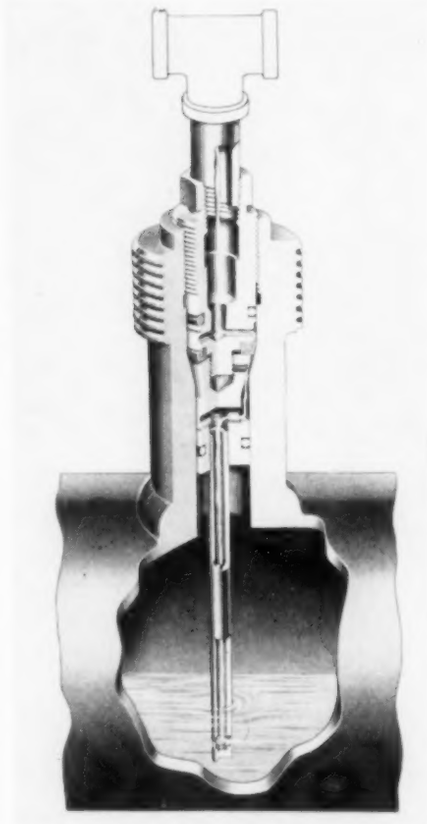
D. W. Onan & Sons, Inc., has incorporated several design changes in its new 6,000-watt, air-cooled diesel electric generating plant.

The Model 6DRN was developed for wide-spread general electric power applications by construction firms, oil fields and industry. It also can be adapted to below-deck marine applications.

The unit is powered by a 13.5 hp Onan 4-cycle, full diesel engine. The engine features a Vacu-Flo cooling system which employs a powerful centrifugal blower that pulls cooling air through the generator and over the heated engine parts, then expels the heated air through a duct to the outside.



For more data, circle **No. E4** on Readers' Service Card, last page this issue.

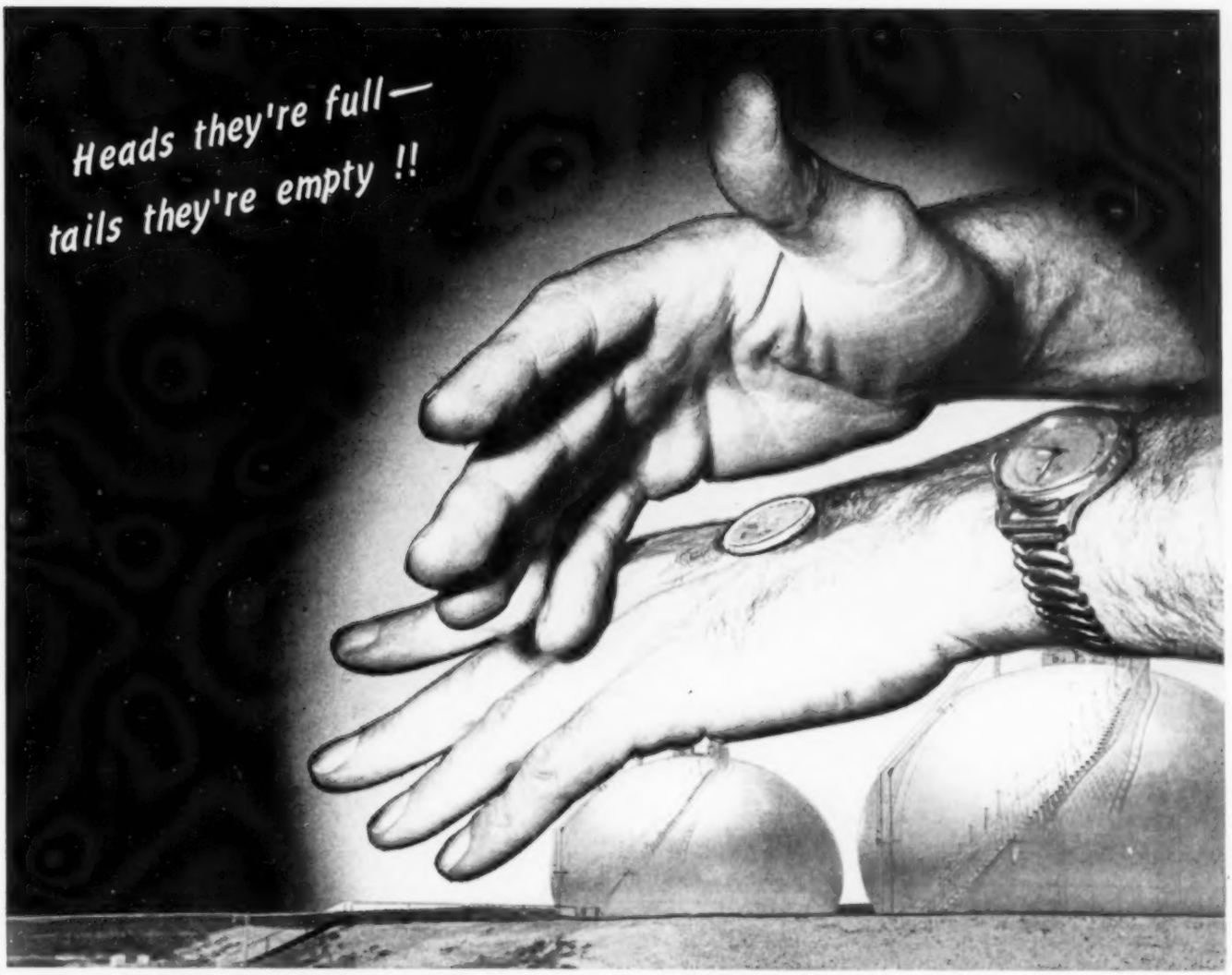


Product Sampler

A simplified corrosion survey instrument for taking product samples under full pressure and normal operating conditions has been introduced by Cosasco Division of Perfect Circle Corporation. The new corrosion tool permits line fluids or gases to be sampled at will without system shutdown.

The sampler incorporates special design features for sealing off top of the line or vessel, permitting samples to be taken from bottom or any other desired position in the line.

For more data, circle **No. E5** on Readers' Service Card, last page this issue.



UNCERTAINTY can be ELIMINATED in spite of the odds

Wind • Rain • Lightning • Hail • Snow • Sleet • Ice • Blistering Heat • Swirling Sand • On Stream Tanks

In the face of all these, and at finger tip convenience in an office located hundreds of miles from your pipeline stations, you want readings from **LIQUID LEVEL GAUGES – TEMPERATURE BULBS – POSITIVE DISPLACEMENT METERS – AND PRESSURE GAUGES.** You want to be notified about alarm conditions, valve positions and expect an infallible "automatic deliveryman" (L.A.C.T.). You not only want these things at a moment's notice but want them recorded in digital and alphabetical form as a documented custody transfer record. You demand **ACCURATE INFORMATION – – – RELIABLE PERFORMANCE – – – THE SCOPE AND MAGNITUDE TO HANDLE ONE OR A HUNDRED TANKS** and the **FLEXIBILITY** that will permit future expansion.

Mr. VIP – – – you are DEMANDING a

"Varec" PULSE CODE telemetering system

FOR A COMPLETE ENGINEERING APPROACH TO TELEMETERING SYSTEMS REQUEST PACKAGE 24

THE VAPOR RECOVERY SYSTEMS COMPANY • COMPTON, CALIFORNIA

Direct Gas Measurement

Black, Sivalls & Bryson, Inc., in cooperation with General Electric Company, announces an instrument to directly measure gas and liquid flow in pounds. The device measures the weight of flowing fluids with high accuracy over wide ranges of flow rate, pressure, temperature and density. First production units will be available in 1960; prototype production units will be field tested in various natural gas services this year.

(This item supplements General Electric Company data on pages 199-202 of the Pipe Line Catalog, Second Revision.)

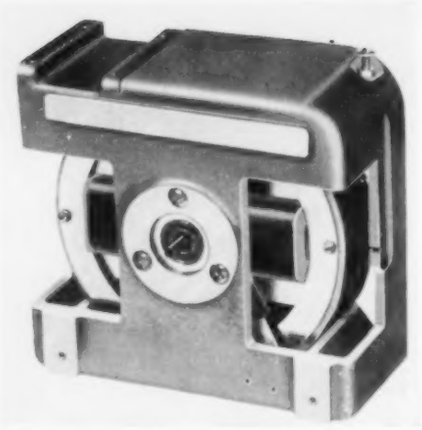
For more data, circle **No. E6** on Readers' Service Card, last page this issue.

Curved-Shank Ripper Tooth

Caterpillar Tractor Company announces a new curved-shank ripper tooth to its line of optional equipment. Curved at a slight angle, it is designed to eliminate rock drag and slabbing. Through adjustments to the tooth at the clevis, ripping angles and depths can be varied through three positions. Made of steel plate, the tooth is less subject to damage caused from heavy impact.

(This item supplements Caterpillar Tractor Co. data on pages 76-79 of the Pipe Line Catalog, Second Revision.)

For more data, circle **No. E7** on Readers' Service Card, last page this issue.



Electrical Encoder

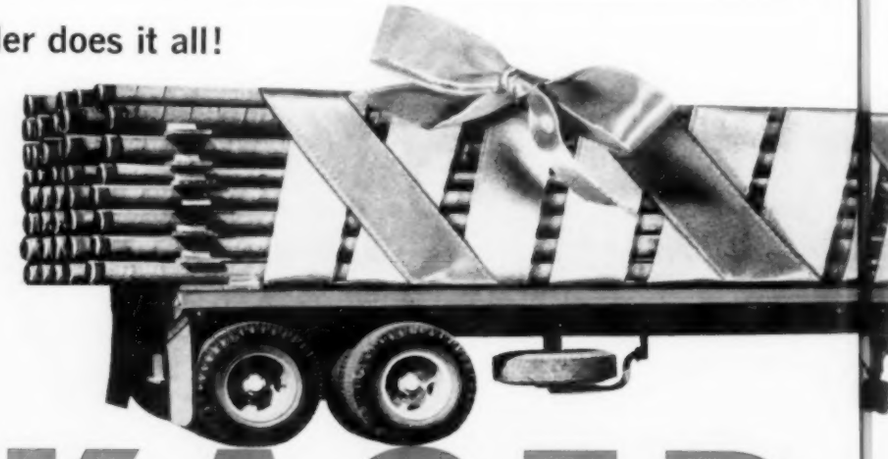
Norwood Controls has developed a new encoder for converting rotary motion to a coded electrical output suitable for long-distance transmission and logging.

The ElectroSyn Encoder is used to transmit and log temperature and pressure readings and can be applied in any situation involving a shaft whose rotation may be stopped for short intervals. A coded output is obtained by using a metal-clad plastic disc with read-out brushes which are not normally in contact. Closing a read-out switch puts the brushes in contact with concentric, printed circuit tracks on the disc and then closes another switch which energizes the disc and contacts.

(This item supplements Norwood Controls data on pages 305-328 of the Pipe Line Catalog, Second Revision.)

For more data, circle **No. E8** on Readers' Service Card, last page this issue.

Lower costs! One purchase order does it all!



PACKAGED

NOW—A REVOLUTIONARY NEW LOW-COST CONCEPT IN PIPE BUYING

Southern Pipe PACKAGED PIPELINES offer you a brand new way to save money, cut red tape, eliminate worries. One order does it all—from pipe production and processing to trenchsite delivery. You buy one complete pipeline package, delivered when you need it.

Write for LITEWALL PACKAGED PIPELINES brochure today.

SP-26-59 © 1959—So. Pipe • Div. of U.S. Industries, Inc.

Gate Valves

A new line of pressure sealing gate valves that provide a tight seal both up and downstream and require no lubrication, has been introduced by W-K-M division of ACF Industries, Inc.

The valves incorporate a full bore and through conduit, seats that automatically adjust for wear, automatic upstream relief for excessive body pressure and ease of maintenance.

(This item supplements W-K-M data on pages 461-520 of the Pipe Line Catalog, Second Revision.)

For more data, circle **No. E9** on Readers' Service Card, last page this issue.

Gasoline Power Engines

International Harvester Company's Construction Equipment division has introduced three heavy-duty gas engines. The units include two six-cylinder carbureted models, the UC-263 and UC-221, and the four-cylinder carbureted UC-135.

The most powerful engine—the UC-263—develops 95 hp at 2,400 rpm. The UC-221 produces 75 hp at 2,400 rpm and the UC-135 is rated at 42 hp at 2,000 rpm.

The new units offer fuel-saving combustion on gasoline, LPG or natural gas; efficient valve-in-head design, long life pressure lubrication; replaceable sleeves; thorough sealing against life-shortening dust; and updraft carburetion.

For more data, circle **No. E10** on Readers' Service Card, last page this issue.

Aluminum Fenders

Master Tank & Welding has introduced single piece aluminum fenders for trucks and trailers. The light fenders allow greater pay loads by decreasing dead weight. The edges are smooth and streamlined in design.

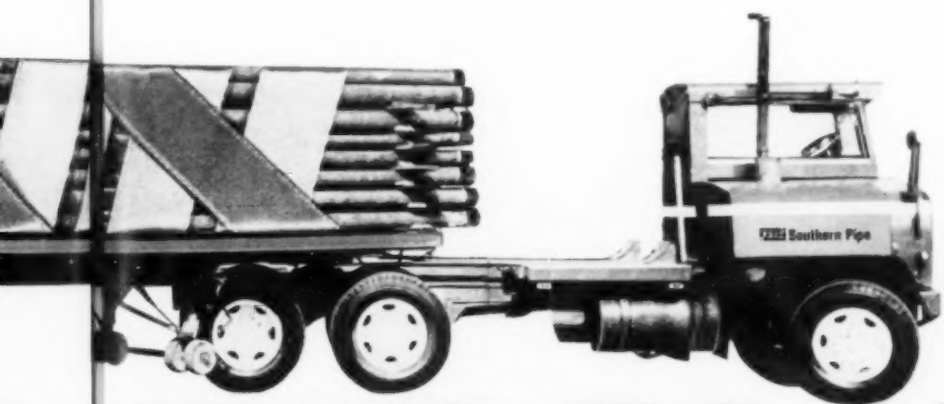
Master contour fenders are available for dual, tractor trailer and step-down equipment and come with or without flaps.

For more data, circle **No. E11** on Readers' Service Card, last page this issue.

Pipe Insulator Tester

The Good-All Electric Mfg. Co. announces a pipe insulator tester. The tester applies an ac signal across the insulator and then detects current flow. Features of the small unit include a transistorized amplifying circuit, it is light, compact and rugged, and the basic detector unit takes accessories for checking pipe of any diameter.

For more data, circle **No. E12** on Readers' Service Card, last page this issue.



PIPELINES

SOUTHERN PIPE PACKAGED PIPELINES GIVE YOU: (1) pipe produced to your exacting specifications, (2) from steel coil in our own pipe mill, (3) cut precisely with NO random lengths, (4) coated (or lined) at our plant, (5) warehoused, if necessary, until you need it, and (6) delivered to your trenchsite ready for welding and placing in trench. **PACKAGED PIPELINES** come in API monogrammed pipe or in Southern Pipe's own LITEWALL pipe—a new high strength, lightweight pipe manufactured to API specifications. (Southern Pipe warehouses standard sizes for immediate delivery, too.)

USI Southern Pipe DIVISION OF U.S. INDUSTRIES, INC.
P.O. BOX C • AZUSA, CALIFORNIA • CUmberland 3-7111 – EDgewood 7-1221

HALLMARKS of QUALITY

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Since specialization began, the finest craftsmen have stamped their work with symbols that attest to the quality of their products.

Our hallmark of quality coating and wrapping, affixed to the kraft wrapper of your pipe, assures you that the pipe has been treated according to rigid specifications and procedures, Standard Procedures, which establish the highest standard of quality for pipe protection.

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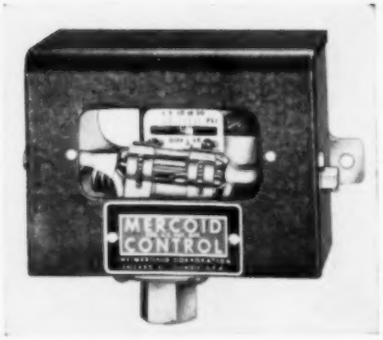
3000 SOUTH BRENTWOOD BLVD. • ST. LOUIS 17, MO.



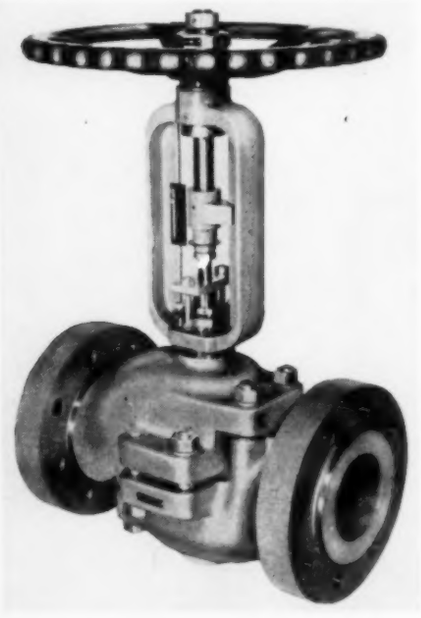
Pressure Control

The Mercoid Corporation announces its newly designed pressure control which is particularly suitable where space is limited. The small, compact unit features external adjustment, repetitive trip point, visible calibrated dial with pointer, visible hermetically sealed mercury contact and steel cover with glass front.

The operating range is from 1 to 20 psi; differential of 0.5 psi and maximum pressure of 30 psi.

(This item supplements Mercoid Corporation data on pages 290-291 of the Pipe Line Catalog, Second Revision.)

For more data, circle **No. E13** on Readers' Service Card, last page this issue.



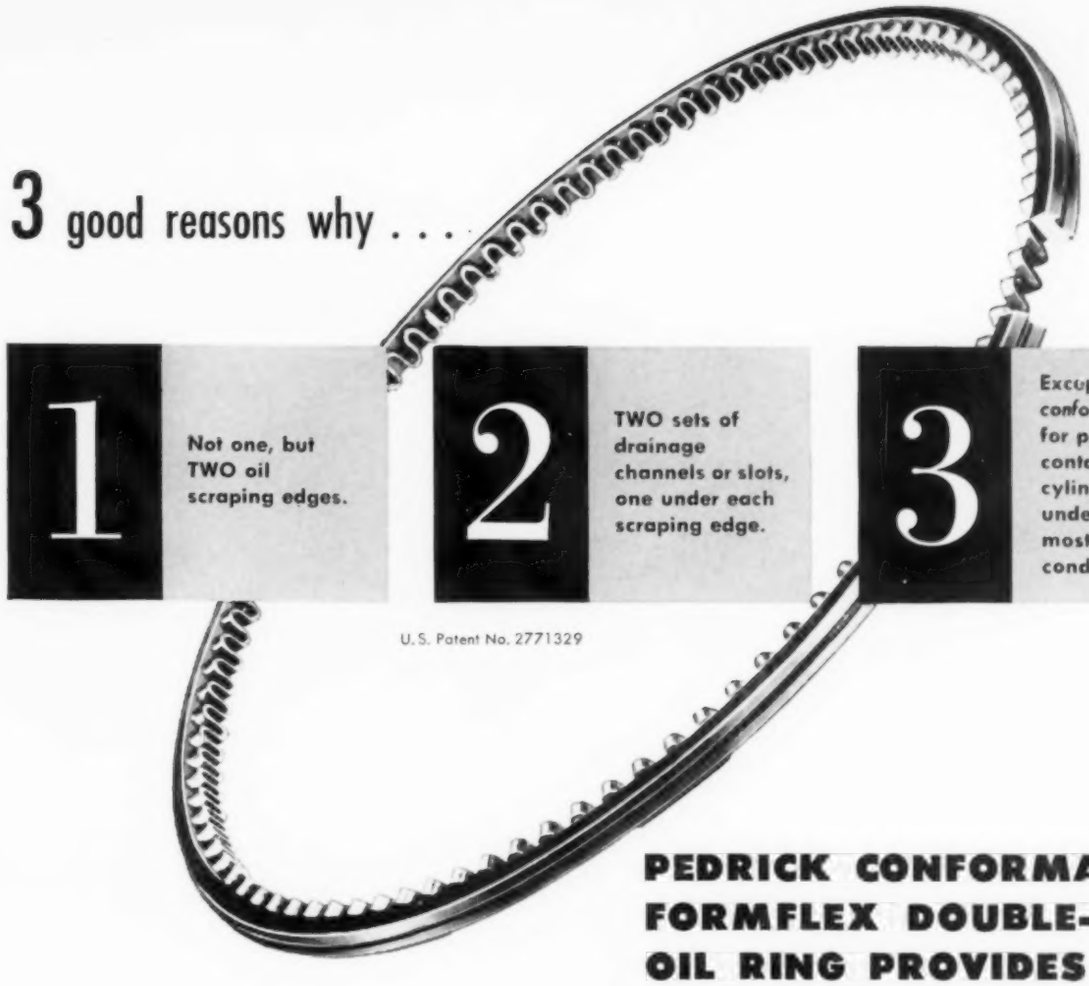
Manual Control Valves

Conoflow Corporation announces a new line of handwheel operated control valves, designated series LM valves. The valve consists of a single-seated valve body with extra thick body walls cast to 600 pounds ASA rating. It is especially suited to solve corrosion and erosion problems encountered when using hard to handle process fluids.

The valve can be converted to fully automatic or remote manual operation by mounting a pneumatic cylinder or spring and diaphragm actuator.

For more data, circle **No. E14** on Readers' Service Card, last page this issue.

3 good reasons why . . .



1 Not one, but TWO oil scraping edges.

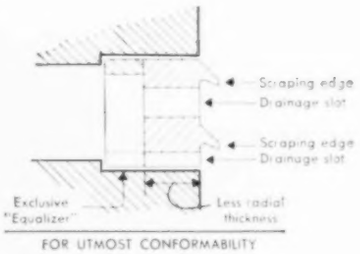
2 TWO sets of drainage channels or slots, one under each scraping edge.

3 Exceptional *conformability* for positive contact with the cylinder wall under even the most severe conditions.

U.S. Patent No. 2771329

PEDRICK CONFORMABLE FORMFLEX DOUBLE-DRAIN OIL RING PROVIDES IMPROVED OIL CONTROL

. . . especially on pistons with oil drainage through the grooves instead of below the grooves.



FOR UTMOST CONFORMABILITY

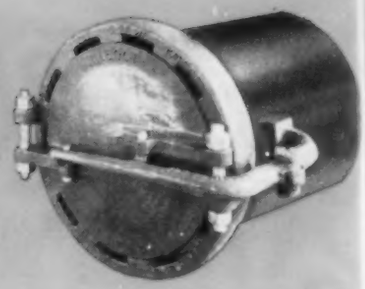
Users find the Pedrick FORMFLEX Double-Drain DD8 oil ring provides quicker, more effective drainage, giving improved performance in all piston groove designs. And they like its moderate cost . . . the way it installs without difficulty.

You can depend on its conformability. Pedrick's exclusive "Equalizer" steel expander ring exerts a uniform pressure all the way around the cast-iron cylinder-contacting ring. Radial thickness of the cast-iron ring is less, increasing its flexibility.

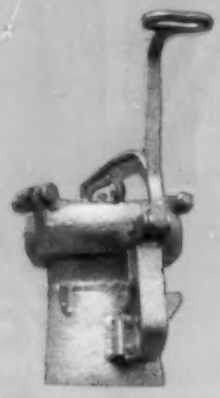
The DD8 Design Conformable FORMFLEX oil ring is just one of many designs available from Pedrick to help give you long-lived, dependable, low-cost engine operation. Say the word and our Engineering and Consulting Service are at your service. Write, wire or phone: WILKENING MANUFACTURING Co., Philadelphia 42, Pa., Tel.: SAratoga 9-3770. *In Canada:* Wilkening Manufacturing Co. (Canada) Ltd., Toronto 2.

Pedrick PISTON RINGS

PEDRICK PIONEERED *conformable* RINGS FOR BIG-BORE ENGINES



Hinged Type UNIBOLT Scraper Trap Closures conform to ASA 150 through ASA 900 Ratings, and are available in sizes from 4" through 42".



The UNIBOLT Gas Line Blow-Off Head also employs only two bolts and is hinged for easy opening and closing. The closure can be furnished with bleeder plug to safely relieve pressure which may leak through the riser valve.

catch your pig in a UNIBOLT trap!

The UNIBOLT Hinged Scraper Trap with self-sealing gasket swings open and shut like a door, and there are only two bolts to release and make up. Nothing to lift, nothing to fall on workmen, no time-consuming multi-bolt flanges, *and no leaks!* The self-sealing gasket, which rarely needs replacing, is the final answer to scraper trap leaks. Its lipped design makes it self-sealing under line pressure. The coupling cannot be over-tightened to the extent of damaging the gasket or the coupling itself.

When installed on an oversize barrel (slightly larger than the o.d. of the pig), it's easy to get a pig in and out of the trap. Line pressure does the heavy work.

These simple, convenient closures are equally desirable for gas line blow-off heads (see above), strainers, product line terminal manifolds, or any other service where pressure vessels must be opened for inspection, cleaning, repairing, connecting to a line, etc.

Please send for Bulletin PL-590 for complete details.

THORNHILL CRAVER CO.
P. O. BOX 1184 HOUSTON, TEXAS

Pipe Line Control System

Clark Bros. Co. has developed a new line of control systems for pipe line compressor automation. Consisting of three basic control panels, the "packaged automation" ranges from a simple engine start system to a fully automatic engine and compressor control for remote location. With the addition of a computer controller and telemetering equipment, any number of remote automatic panels can be tied together for the automation of a complete station or pipe line.

The basic control panels consist of the Model SE Sequenced Engine Control which permits operator to start or stop compressor engine by pushing a button; the Model SEC Sequenced Engine and Compressor Control which combines all functions of engine and compressor in one panel; and the Model SEC-R Fully Automatic Engine and Compressor Control for Remote location has facilities to tie-in to computer and entire pipe line control system.

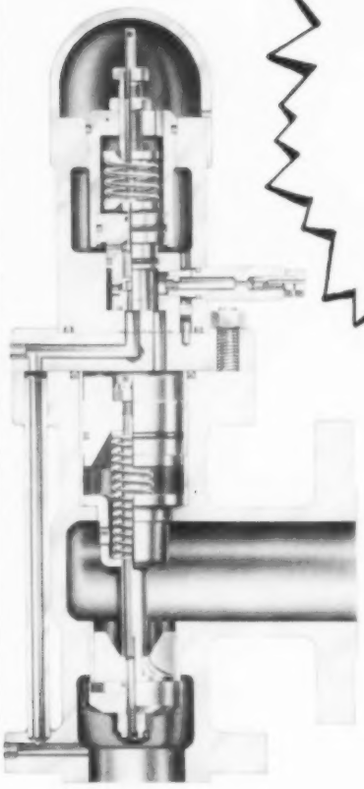
(This item supplements Clark Bros. Co. data on pages 89-92 of the Pipe Line Catalog, Second Revision.)

For more data, circle **No. E15** on Readers' Service Card, last page this issue.

Plastic Lined Pipe

Jones & Laughlin has developed and tested a Jal-Jacket pipe, which consists of a polyvinyl chloride lining encased in a steel jacket. The plastic lining gives the pipe resistance to corrosive fluids while the steel jacket gives it strength to carry fluids and gases under high pressure. Jones & Laughlin has used the pipe in a test to carry coal slurry 350 feet from pulverizers to a collecting point.

For more data, circle **No. E16** on Readers' Service Card, last page this issue.



INSTANTANEOUS OPENING FOR GAS OVERPRESSURES

MODEL 416 RELIEF VALVE ASSURES POSITIVE PROTECTION

The new pilot operated Kinzbach Model 416 Relief Valves were designed to be the most dependable relief valve for gas services. Whenever line pressure reaches set pressure the pilot valve opens and full line pressure is applied to the main valve, opening it through its full stroke without pressure accumulation.

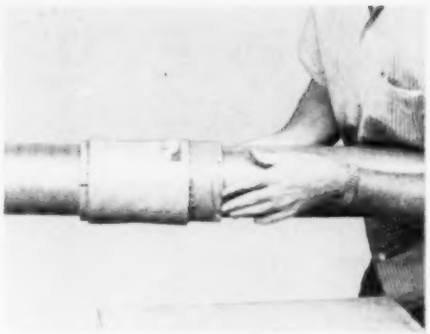
This flat-seated pilot valve has a stainless steel loading spring which makes possible an extremely accurate set pressure and years of trouble-free performance. Some other advantages of this simple and rugged valve include its positive leakproof seating, easy functional testing below set pressure, and convenient bench setting for both opening and closing pressure. The Model 416 Valves are Certified under A.S.M.E. Unfired Pressure Vessel Code (Sec. VIII, Par. UG-131).

For complete details on this and other Kinzbach Relief Valves, write for new catalog.

KINZBACH TOOL CO INC

KINZBACH TOOL CO., INC.
P. O. Box 277 • Houston, Texas

EXPORT OFFICE:
74 TRINITY PLACE
NEW YORK, N. Y.



Polyethylene Coating

A sprayable high-density polyethylene coating has been made available by the plastics division of Koppers Company, Inc. The coating features strong adhesion qualities on a variety of surfaces. It may be applied at room temperatures by conventional coating methods, and the coated part is subsequently heated to about 400° F. to fuse the coating and bond it to the surface. The coating is based on super dylan polyethylene.

For more data, circle **No. E18** on Readers' Service Card, last page this issue.

Reinforced Plastic Pipe

Amercoat Corporation has made available a broad new range of fittings in its epoxy-and-fiberglass pipe. The new fittings include 90 degree and 45 degree elbows, tees, couplings and other fittings for either threaded-end or plain-end Bondstrand pipe. The pipe comes in rigid 20-foot lengths in 2 to 8-inch diameters; larger sizes are available on special order.

For more data, circle **No. E17** on Readers' Service Card, last page this issue.

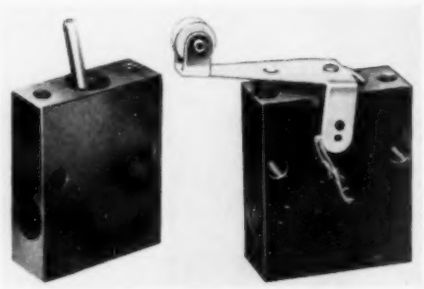
Micro-Valves

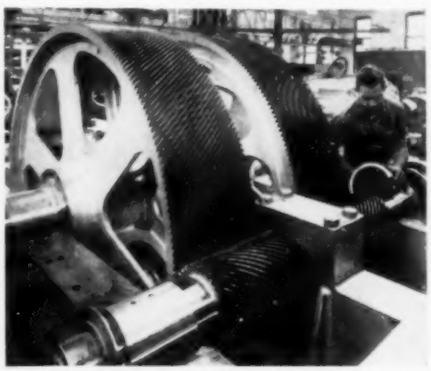
Instruments, Inc., announces its new miniature valve—Micro-Valve—with an overcenter, snap-action operator. The basic valve is a 3-way, 2-position valve and may be adapted easily for 2-way shut-off service. Four-way combination valves also are available.

Features of this model include fast, positive action in any gas or fluid service; tight shut-off; small size, light weight, and light operating force requirement. Operating pressures are from 0-100 psi with orifice sizes to ⅛-inch diameter. Various mechanical and solenoid operators, as well as porting and manifolding arrangements are offered.

(This item supplements Instruments, Inc., data on page 250 of the Pipe Line Catalog, Second Revision.)

For more data, circle **No. E19** on Readers' Service Card, last page this issue.





Compressor Speed Increaser

Westinghouse Electric Corporation announces a large speed increaser for use in compressor stations. In operation at a station a large synchronous motor operating at 900 rpm drives the speed increaser which in turn is coupled to a centrifugal compressor.

Pressure lubrication to all bearings and gear mesh is provided by a force-feed lubrication system. A three section fabricated housing protects the gearing mechanically, provides permanent alignment and insures stability of operation.

For more data, circle **No. E20** on Readers' Service Card, last page this issue.

Turbocharged Compressor

Clark Bros. Co. announces a new turbocharged model to its line of HMB 2-cycle packaged field compressors. Horsepower output has been increased 20 percent over similar Clark nonturbocharged units.

Furnished as a complete package the TMB includes gas engine compressor, radiator, scrubbers, starting air compressor, and other accessories mounted on a steel skid.

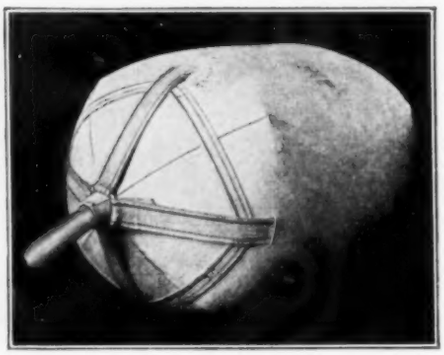
An inclined vertical air flow radiator provides ample cooling capacity to meet the most adverse conditions. Because scavening air is cooled, the units have high resistance to detonation, even in areas of high ambient temperature.

(This item supplements Clark Bros. Co. data on pages 89-92 of the Pipe Line Catalog, Second Revision.)

For more data, circle **No. E21** on Readers' Service Card, last page this issue.

THE GOODMAN CYLINDRICAL STOPPER

FOR GAS, OIL, WATER AND DRAIN PIPES



The Goodman Cylindrical Stopper is an inflatable bag with a rugged water-proofed casing which may be inflated to a high internal pressure and will hold against as much as ten pounds pressure in the pipe.

The broad central zone makes contact with the wall of the pipe and holds against a higher pressure than other types of bag.

This Stopper has been used successfully for testing soil pipes in new buildings and for stopping oil pipes around refineries. Water-works engineers use it to save pumping while altering or repairing mains where leaky valves are encountered. It is now giving satisfaction in sewer work, and in at least one instance it saved a city water-works a large expenditure of money.

Safety Gas Main Stopper Co., Inc.

523 ATLANTIC AVENUE

BROOKLYN 17, N. Y.

Go-Devil

NORTHRUP GO-DEVILS

Heavy Duty Model with Neoprene cup or disc drivers

G. A. COTTEN CO.

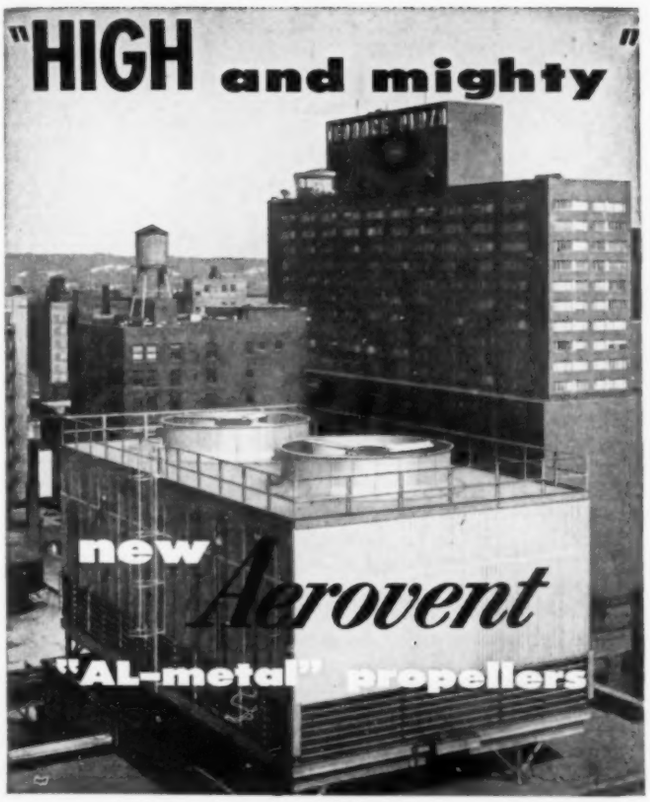
Manufacturers of **TRANSIT PIPE LINE SCRAPERS**

NORTHRUP GO-DEVILS &

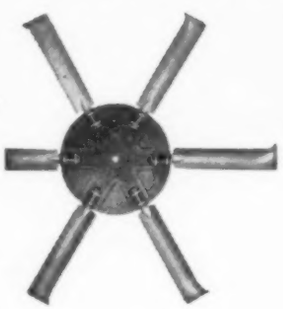
P. O. Box 5332

Tulsa, Okla.

"HIGH and mighty"



move mountains - of AIR!
in towers and exchangers



- Sizes 14' to 18'
- 4 or 6 blades

Developed originally for the petroleum industry, Aerovent Large-Diameter "Al-metal" Propellers, constructed of tough, durable aluminum alloy, move great quantities of air at high velocities, in heat exchangers and cooling towers. Pictured above are two 4-blade, 16-ft. propellers in a cooling tower installation. These mighty propellers, with adjustable-pitch "Macheta" Airfoil blades, are job-engineered to individual specifications.

Write for free Bulletin 510

DESIGNED FOR DEPENDABLE OPERATION!

Endurance tests, conducted at *3 times* normal loading prove the ability of these new large-diameter propellers to withstand severe punishment. Heavy-duty cast steel hubs offer maximum resistance to stresses. Angle settings for each operating requirement, and appropriate alternate settings, assure accurate pitch for any predetermined performance which may be required. 54" to 144" now available in Adjustable Pitch models.

REFINERIES, pumping stations, industrial plants and commercial buildings use Aerovent "Al-metal" Propellers in major air-moving applications.

Aerovent FAN COMPANY, INC.
LARGE PROPELLER DIVISION
304 Wright Bldg.
TULSA 3, OKLA.
Main Office and Factory
PIQUA, OHIO

As SIMPLE and Dependable as the Pull of a MAGNET!

A sleeve, raised and lowered within a non-magnetic tube, attracts or releases an Alnico magnet attached to a mercury switch. Basically, this is Magnetrol.

MAGNETROL

The Simplest, Most Versatile
LIQUID LEVEL CONTROL
Ever Devised!

Linked to liquid level by infallible magnetic force, Magnetrol is free from the limitations inherent in mechanical or electrical controls. With the actuating magnet rated at 98% of initial strength after 30 years, Magnetrol has *infinite operating life*, with practically no maintenance at all. There are no wearing parts to get out of order.

What's more, Magnetrol's simple operating principle permits easy, economical modification of standard units to meet *any* pressure, temperature or corrosion requirements. That's why there's practically no limit to Magnetrol's use. It's also why "specials" are likely to be standard with us. Magnetrol units control level changes from .0025-in. to 150-ft. —with single or multi-stage switching.

MAGNETROL, Inc.

● SEND COUPON FOR DETAILS

MAGNETROL, Inc. 2128 S. Marshall Blvd., Chicago 23, Illinois 5
Please send me catalog data and full information on Magnetrol Liquid Level Controls.
Name _____
Company _____
Address _____
Zone _____ State _____

For more data on advertised products, use Readers' Service Cards, last page.

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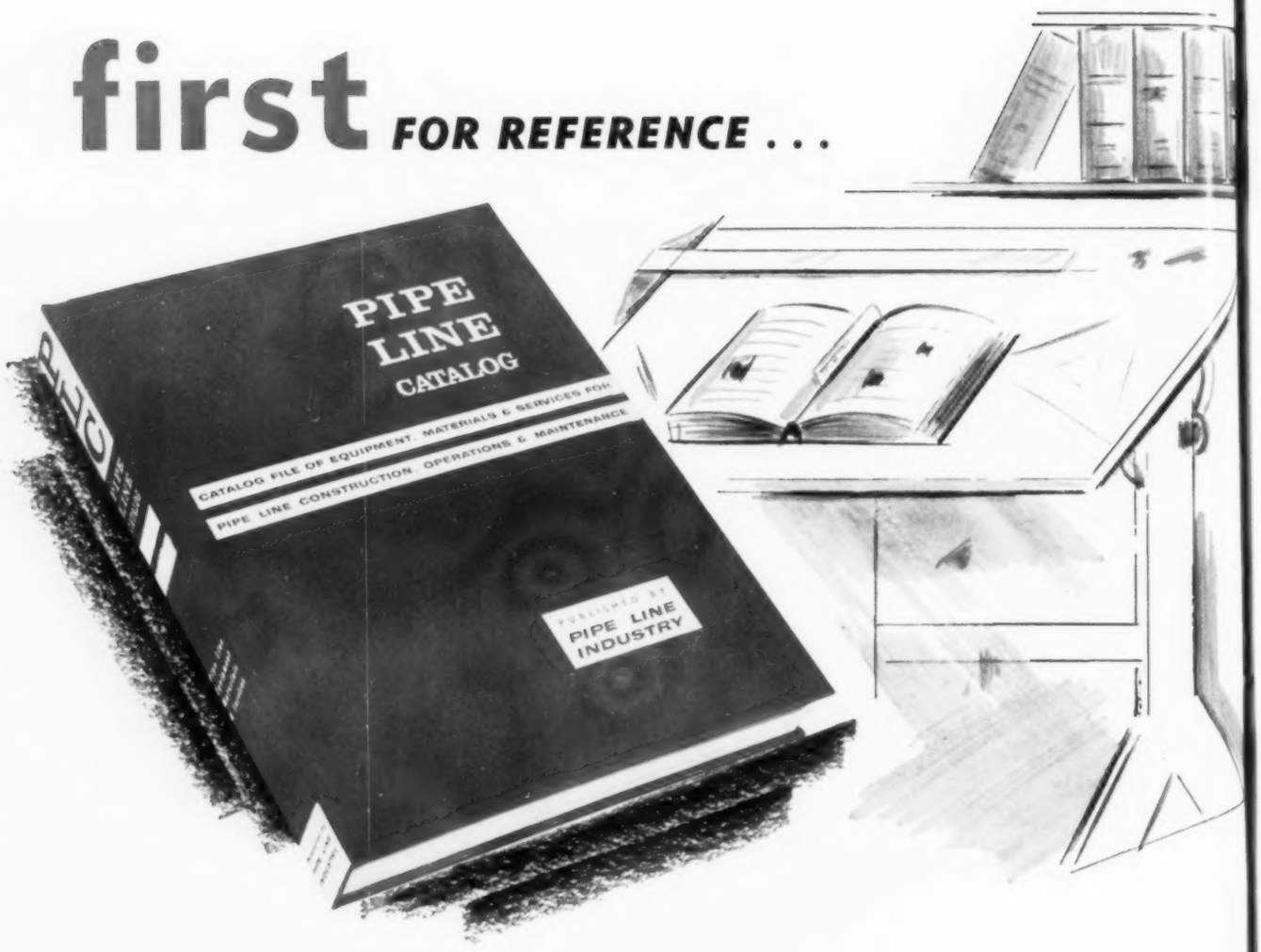

A *one-volume reference library* for purchasing and specifying. That's the best way to describe the only comprehensive catalog data file published specially for the Pipe Line Industry. Convenient to handle, thoroughly indexed, it is saving time and money for thousands of pipe line men.

first *FOR INFORMATION ON MANUFACTURERS AND SERVICE COMPANIES*

Included in 169 equipment and service companies' data in PLC, are more than 1,650 manufacturers' representatives and sources of supply listed.

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first *FOR INDIVIDUAL EQUIPMENT AND SERVICE ITEMS*

There are more than 11,000 equipment and service items cataloged, with detailed information on specifications, installation, operation, maintenance, service—an entire library of useful reference.

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first *FOR CONSTRUCTION EQUIPMENT AND SERVICE*

Pipe Line construction and service items listed in PIPE LINE CATALOG exceed 400...an invaluable aid to office and field specifications and purchases.

•

When you are ready to buy or specify, or if you just want planning information, look first in PIPE LINE CATALOG.

PIPE LINE CATALOG

Published by PIPE LINE INDUSTRY

P. O. BOX 2608 HOUSTON, TEXAS

DESTINATION: TOMORROW!

TODAY THE E/A SHOULDER HOLIDAY DETECTOR AND THE E/P PULSE TYPE DETECTOR FOR DAMP CLIMATES ARE ANSWERING THE PIPELINER'S NEED FOR A DEPENDABLE, FULLY PORTABLE, GENERAL PURPOSE ELECTRICAL INSPECTION INSTRUMENT.

BOTH MODELS CAN BE USED FOR A FULL DAY WITHOUT RECHARGING THE BATTERY. ALL WRAPPED SURFACES INCLUDING PIPE CAN BE QUICKLY AND ACCURATELY INSPECTED FOR VOIDS, PINHOLES, BREAKS, SCRATCHES AND BURNED OR COKED SPOTS.

TOMORROW THESE SAME DETECTORS WILL BE USED IN THE INSPECTION OF TUBING ON OUTER SPACE ROCKETS; FOR TINKER & RASOR DETECTORS ARE DESIGNED FOR THE FUTURE.

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Electronic Detectors for every Industry

TINKER & RASOR

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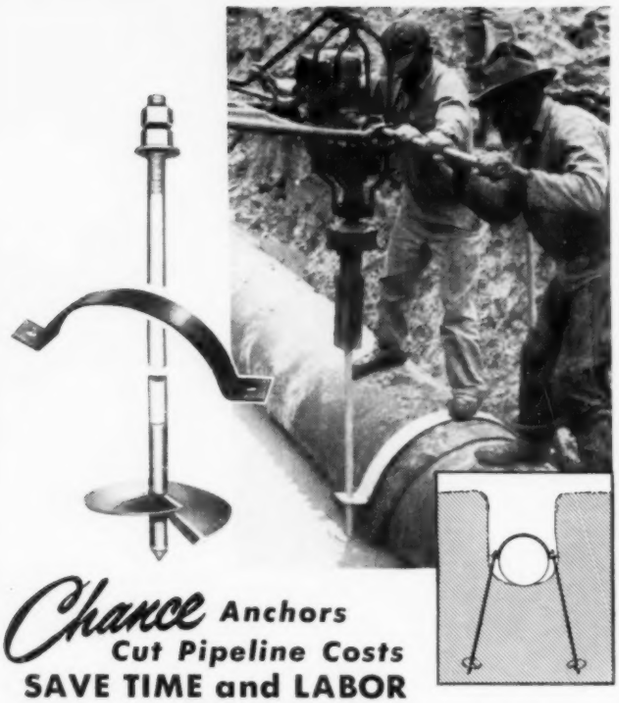

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Cut Pipeline Costs
SAVE TIME and LABOR

The modern, effective method of anchoring pipeline is with Chance Pipeline Anchors and Brackets. It is the lowest cost, easiest, surest way to keep pipe from floating. Can be installed with hand tools or light power equipment.

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Clean PIPELINES
Reclaim TANK BOTTOMS
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BrakeSol
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PARAFFIN TREATING CHEMICAL

BRAKESOL holds paraffin in suspension! Inject it into gathering lines and BRAKESOL keeps them free of paraffin.

BRAKESOL reclaims tank bottoms without taking tanks out of service! BRAKESOL chemically dissolves paraffin and puts it back in solution into the oil. Cost is nominal compared to savings.

BRAKESOL is safe to handle and will not harm your equipment. Let BRAKESOL eliminate your paraffin problems NOW!

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For Pipe Line Men

PIPE LINE CORROSION and CATHODIC PROTECTION

By Marshall E. Parker

This book is designed as a practical field manual. It provides workable methods that can save you valuable time and effort in obtaining interpretive field data. **Contents (Condensed).** Soil Resistivity Surveys, Pipe-to-Soil Potentials, Line Currents, Current Requirement Surveys, Rectifier System for Coated Lines, Ground Bed Design and Installation, Magnesium Anodes and Coated Lines, Hot Spot Detection, Stray Current Electrolysis, Interference in Cathodic Protection, Operation and Maintenance, Coating Inspection and Testing. Appendices cover: Fundamentals of Underground Corrosion, Basic Principles of Cathodic Protection. Plus . . . tables and properties of metals, attenuation equations and index.

108 pages, illustrated.....Price $3.00

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P. O. Box 2608 Houston 1, Texas

New Equipment Literature

For more data on New Equipment or copies of Catalogs and Literature reviewed in this issue, use the Reader Service postcards just inside the back cover and facing the Advertisers Index. Simply circle code numbers of items desired—sign and mail card.

Valve Regulators

Rockwell Manufacturing Company announces a bulletin covering the functions, applications and operation of its valve regulators with republic controls.

The regulators are pneumatically controlled, cylinder operated, lubricated plug valve regulators designed to provide high-pressure, large volume, gas regulation with minimum pressure loss. Republic controls, consisting of an accurate, vector type, pressure controller and a feed-back type valve positioner give regulators greater sensitivity. Included in the eight-page, photo-illustrated bulletin are regulation capacity tables for the complete line—6 inch through 16 inch.

To get a copy, circle **No. E22** on Readers' Service Card, last page this issue.

Shaft Seals

Borg-Warner Mechanical Seals has released a new, four-page bulletin describing its line of precision shaft seals. Ranges for standard types are given and engineered models offered for other applications.

To get a copy, circle **No. E23** on Readers' Service Card, last page this issue.

"O" Rings Design

Garlock Packing Company announces availability of a bulletin on design and application of "O" rings. The 20-page booklet discusses materials of construction, dynamic and static applications, use of back-up or non-extrusion rings, and groove design for this style of packing.

To get a copy, circle **No. E24** on Readers' Service Card, last page this issue.

Control Valves

Fisher Governor Company has completed a 25-minute, 16 mm film titled "Muscles of Control" which shows how control valves function and how they are engineered. Various types of power actuators from pneumatic to electro-hydraulic are demonstrated.

Special camera and animation techniques were used to reveal what happens inside the valve body under normal and extreme operating conditions. Cavitation and turbulence are shown and explained as well as the effects of corrosion and erosion on plugs and seats.

To get a copy, circle **No. E25** on Readers' Service Card, last page this issue.

Accessory Test Kits

Associated Research Incorporated has issued a two-page flier and data sheet on accessory test kits. The bulletin includes photographs and descriptions of three models used for electrical geophysical subsurface exploration. The kits are designed to increase effectiveness of ground resistivity testers.

To get a copy, circle **No. E26** on Readers' Service Card, last page this issue.

Trenchers

The Cleveland Trencher Company announces publication of a four-page folder on the three new Cleveland "J" trenchers.

The highly illustrated brochure describes the new design and construction features of the J-20, J-30 and J-40 in terms of how they improve the operation of trenchers. A quick, convenient comparison of the digging capacities, specifications and dimensions of the three trencher models is provided on page four of the folder. Action photographs show the "J" trenchers in typical job conditions.

To get a copy, circle **No. E27** on Readers' Service Card, last page this issue.

Check Valves

Daniel Orifice Fittings Company has issued a revised catalog section (H) on piston controlled check valves. The catalog describes positive control features of the check valves.

Also included in the folder are specifications and parts lists for 300 to 2,500 pounds A.S.A. pipe line, and general use valves; and for 2,000, 3,000 and 5,000 psi (gage) C.W.P., A.P.I., flow-line drilling and production valves in a wide range of sizes.

To get a copy, circle **No. E28** on Readers' Service Card, last page this issue.

Timing Belt Drive

Allis-Chalmers has issued a bulletin on the "Time-Tex" timing belt drive constructed with steel cable cords imbedded in neoprene fully molded with nylon base fabric.

The "Time-Tex" timing belt drive is suitable for a wide range of load applications—from sub-fractional to 600 hp with a torque load range from thousands of foot pounds down to light loads in inch ounces. The drive makes possible a range of speeds from 0 to 16,000 feet per minute.

To get a copy, circle **No. E29** on Readers' Service Card, last page this issue.

Microwave Facilities

General Electric Company has issued a new series of microwave bulletins, featuring channel facilities in G-E 2KMC systems.

The bulletins describe terminal stations, multiplex repeaters and junctions which serve as the "doors" through which information comes into and departs from the microwave carrier. An application table shows how services such as teletype, telemetry, supervisory control and telegraph are applied to the carrier.

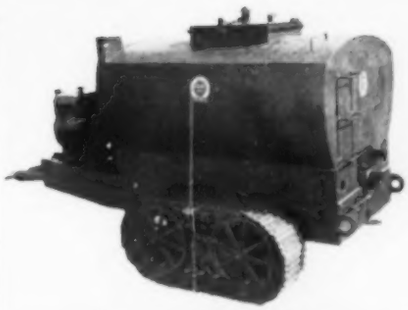
To get a copy, circle **No. E30** on Readers' Service Card, last page this issue.

Fork Lift

Operating advantages of the new Case 310 utility fork lift, plus general specifications, are shown in a two-color bulletin recently released by J. I. Case Co.

The 4,000-pound fork lift is powered by a 42 hp gasoline engine and operates up to 18 mph on big, cushioning tires.

To get a copy, circle **No. E31** on Readers' Service Card, last page this issue.



HOT DOPE FROM MYOCO KETTLES

Dope stays hot and properly mixed when you use a MYOCO asphalt kettle. Completely insulated, it provides guaranteed heat retention, assuring almost no temperature differential of filler between top and bottom. Coking is unnecessary.

Settling is prevented through two-way agitation—a mechanically driven propeller and hydraulic bottom sweep.

Additional time, labor and money savings result from the MYOCO asphalt kettle's design, which eliminates the need for over-width highway transportation permit.

Safety is assured, since fuel tank is installed inside of frame and protected from firebox by bulkhead.

The MYOCO asphalt kettle is available in 10, 27, 30 barrel sizes, powered by a Wisconsin engine or its electric equivalent, and with Athey tracks, steel skids, or fitted for stationary use. Blower or mailbox type burners are optional.

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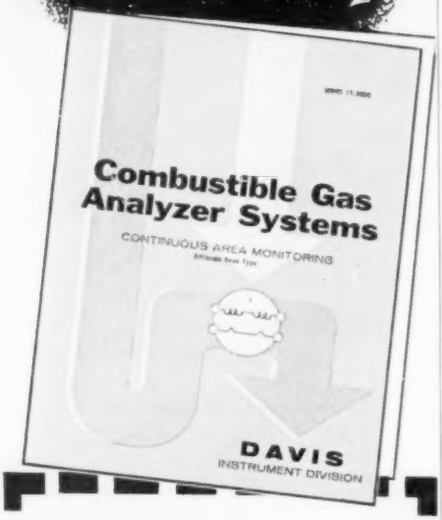

DAVIS INSTRUMENTS
278 Halleck St., Newark, N. J.

Please send Bulletin No. 11-30 with complete details on the new

DAVIS
Combustible Gas Analyzer Systems

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Advertisers' Index

• Dot preceding name of advertiser indicates that detailed data on products and services of the firm will be found in current (1959-60) second revision of The Pipe Line Catalog.

A

• ACF Industries, Inc.
W-K-M Division 31
Acme-Newport Steel Co. 103
Aerovent Fan Company
Large Propeller Division 113a
• Allied Chemical Corp.
Plastics and Coal Chemicals Div. 29
American Pipe & Construction Co. 81

B

• Bethlehem Steel Co. 32-33
Boring & Tunneling Co. of America 98
Brakesol, Inc. 116b
The Bristol Co. 97
Broderick & Bascom Rope Co. 16

C

• A. B. Chance Co. 116c
C. Lee Cook Co. 27
• The Cooper-Bessemer Corp. 12-13
Cosasco Division
Perfect Circle Corp. 19
• G. A. Cotten Co. 112b
• M. J. Crose Mfg. Co. 84

D

Davis Instruments 118a

E

The Early Co. 17
• Thomas A. Edison Industries
Instrument Division McGraw-Edison 5
Emhart Manufacturing Co.
Maxim Division 102

F

Fisher Research Laboratory, Inc. 101a
Fleet-Line Co. 100
• Flexitallic Gasket Co. 20
Ford Motor Co. 14-15

G

• Gaso Pump & Burner Mfg. Co. 26
• Gasoline Plant Construction Corp. 121
General Dynamics Corp. 36
Good-All Electric Mfg. Co. 101b
• Grove Valve & Regulator Co. 10
• Gulf Publishing Co. ..... 94b and 116d

H

Harbert Construction Corp. 35
Hobbs Trailers 18
• Humble Oil & Refining Co. 21
• Hydril Company 122

J

The Jaeger Machine Co. 7
Jo-Bell Products, Inc. 94a
• Johns-Manville Corp. 8-9
Jones & Laughlin Steel Corp. 36-37

K

• Kinzbach Tool Co. 111

L

Lone Star Steel Co. 6

M

• Magnetrol, Inc. 113b
Maintenance Mechanical Corp. 86
Majestic Contractors Ltd. 28a
• F. H. Maloney Co. 22
Maxim Division
Emhart Manufacturing Co. 102
McGraw-Edison 5
• Morris-Young-Owens Co. ..... 88, 99 and 117

N

Nicolet Industries, Inc. 30

O

Oakite Products, Inc. 101c

P

• Peerless Manufacturing Co. 2
• Pelican Supply Co. 118b
Perfect Circle Corp. 19
• Perrault Equipment Co. 96
• Pipe Line Catalog 114-115
Pipe Line Service Corp. 23
Pipe Linings Division
American Pipe & Construction Co. 81
• Plastics and Coal Chemicals Div.
Allied Chemical Corp. 29

R

W. S. Rockwell Co. 93a
Royston Laboratories, Inc. 89

S

Sachse Electric Inc. 94c
Safety Gas Main Stopper Co. 112a
Schramm Inc. 83
Servis Equipment Co. 92
Shand & Jurs Co. 25
A. O. Smith Corp. 90-91
Southern Pipe Division
U. S. Industries, Inc. ..... 106 and 107
Southwestern Pipe, Inc. 11
Southwestern Industrial Electronics Co. 34
Standard Pipeprotection Inc. 108
• Steel Forgings, Inc. 100
Stewart & Stevenson Services, Inc. 24
Stromberg-Carlson Division
General Dynamics Corp. 38

T

• Thornhill-Craver Co. 110
• The Tinker & Rasor Co. 116a

U

Union Wire Rope Corp. 85
• U. S. Industries, Inc. ..... 106 and 107
• United States Motors Corp. 93b
• Universal Oil Products Co. 87

V

The Vapor Recovery Systems Co. 105

W

Western Pipe Line, Inc. 95
Wilkening Manufacturing Co. 109
Williams Pressure Service Co. 28b

Y

Young Radiator Co. 82

Quoted from Mr. Dillard Stokes' Column, Shreveport Journal, Oct 13, 1958.

"President Jefferson feared the justices some day would do what they now are accused of. A few months before he died President Jefferson wrote: 'There is no danger I apprehend so much as the consolidation of our government by the noiseless, and therefore unalarming, instrumentality of the Supreme Court'."

Specify **PELCO** Welding Saddles

PELICAN SUPPLY CO. INC.

P. O. Drawer 1108 Shreveport (84), La.

SEE YOUR NEAREST SUPPLY HOUSE

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E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16
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☐ 1958 Editorial Index

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2 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
24 25 26 27 28a 28b 29 30 31 32 33 34 35 36 37 38 81 82 83 84
85 86 87 88 89 90 91 92 93a 93b 94a 94b 94c 95 96 97 98 99 100 101a
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E17 E18 E19 E20 E21 E22 E23 E24 E25 E26 E27 E28 E29 E30 E31

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2 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
24 25 26 27 28a 28b 29 30 31 32 33 34 35 36 37 38 81 82 83 84
85 86 87 88 89 90 91 92 93a 93b 94a 94b 94c 95 96 97 98 99 100 101a
101b 101c 102 103 105 106 107 108 109 110 111 112a 112b 113a 113b 114 115 116a 116b 116c
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Construction shot of Station #4, on the new Texas to Florida transmission line.

Gas on the move . . . to Florida

The engineering staff of Gasoline Plant Construction Corp. designed four compressor stations for the new transmission line from Texas to Florida. In addition, the supervisory abilities and construction facilities of GPCC were utilized to make sure this new pipeline would be ready to move gas to Florida by the desired completion date.

Over a quarter of a million compressor horsepower has been installed by the engineering and construction crews of Gasoline Plant Construction Corp. in the past twenty-two years. When you plan to expand existing compressor stations or add completely new transmission facilities, utilize this engineering, design and construction experience of Gasoline Plant Construction Corp.

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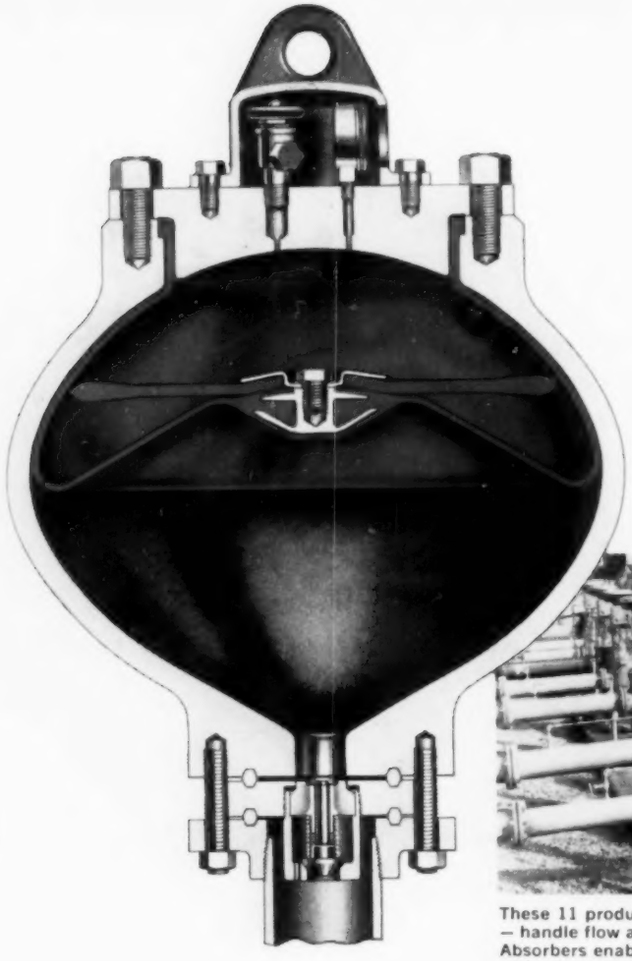
prolongs life of pipelines, fittings and pumps... saves downtime... cuts maintenance costs!



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smooths out shock and pulsation in pipelines

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